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ANGIOID STREAKS OF THE FUNDUS OCULI*

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From a review of the literature on the subject of angioid streaks, it becomes evident that there are at least two distinct types of pigmented striations underlying the retinal vessels and having an arrangement like blood vessels (angioid).

(*a*) The first type was described pathologically by Magitot[1] and more recently by Verhoeff,[2] to whose articles I would refer the reader. Lindner[3] (three of his eight cases), Fleischer[4] and Holm[5] also reported cases of this type, which are distinguished by pigmented spots, usually intermittent and arranged in rows overlying vessels of rather large caliber, apparently part of the choroidal circulation.

(*b*) The second type is characterized by a more or less irregular peripapillary pigmented ring from which offshoots proceed toward the equator. These have an intricate "angioid" branching arrangement, the width diminishing from that of a vessel of the first magnitude near the disk frequently to pointed terminations. The first case described (Doyne, 1889[6]) was of this class, and I wish to add another to the forty-six reports which I have been able to find in the literature.

REPORT OF CASE

An Italian boy, aged 16, first seen on June 7, 1927, gave the following history: The eyes were examined eight years previously at a clinic, when it was found that he had poor vision in the right eye. Unfortunately, I was not able to find the record of this examination, as it had been destroyed. The vision of the left eye had always been normal, as far as he knew, until seven months before I first saw him, when he was kicked in this eye while playing basketball. Estimation of refraction by retinoscopy after dilatation with homatropine revealed a high degree of compound hyperopic astigmatism in the right eye; this was unimproved with a correcting lens ($+4.00 \bigcirc + 1.50$ cylinder axis 105 degrees = 20/70). The left eye

* Submitted for publication, Jan. 26, 1929.

1. Magitot, A.: Ann. d'ocul. **145**:12, 1911.
2. Verhoeff, F. H.: The Nature and Pathogenesis of Angioid Streaks in the Ocular Fundus, J. A. M. A., to be published.
3. Lindner, K.: Arch. f. Ophth. **88**:230, 1914.
4. Fleischer: Klin. Monatsbl. f. Augenh. **53**:430, 1914.
5. Holm, Ejler: Acta Ophth. **2**:152, 1924.
6. Doyne, R. W.: Tr. Ophth. Soc. U. Kingdom **9**:128, 1889.

showed only a small error, which was also unimproved with a correcting lens (+ 0.25 ⊃ + 0.25 cylinder axis 90 degrees = 20/70). Determination of muscle balance, external examination and biomicroscopy failed to show any pathologic changes anteriorly. However, a few fine cobweb strands of persistent pupillary membrane remnants were attached to the collaret of each iris. The lens and vitreous were normal.

Each fundus presented a normal disk and retinal vessels, with no visible abnormality of the choroidal markings. However, pigmented lines of a dark grayish brown were arranged in the form of an irregular ring around the disk, with branching offshoots extending toward the equator of the eye. The arrangement and method of branching suggested a vascular network (from which their name is derived). In places the dark color of the streaks was interrupted at intervals by red portions, which were situated where an underlying choroidal vessel crossed the path of the streak. This was, of course, only ascertainable where the choroidal network was visible, and was well shown over a considerable area below the disk of the left eye, as shown in the accompanying illustration. There was no abrupt line of division between the pigmented and the red portions of the streaks, the change being gradual. These red portions did not have the appearance of extravasated blood but rather of blood flowing through a vessel. Along one margin of some of the streaks (usually the side toward the disk) a narrow, grayish-white border was distinctly visible. The widest portion of the streaks corresponded roughly to the width of a retinal vessel of the first magnitude and diminished toward their peripheral termination to mere lines. The retinal vessels were everywhere superficial to this system of striations. A macular hemorrhage about twice the size of the disk was present in the left eye; it was oval in shape, and extended up and nasally from the fovea.

The fundus was examined with the slit-lamp and the corneal microscope in conjunction with the Koeppe contact glass, and the difference in level between a retinal vessel and an underlying streak was found to be approximately 0.6 mm. This would place the level of the streak in the choroid. With the red-free light the streaks were visible, though less marked than with the ordinary light, their red portions appearing slightly fainter than the retinal blood vessels. Perimetric examination showed normal peripheral limits with an absolute central scotoma in the left eye.

Dr. Amano was able to examine this boy's brother and informed me that he found nothing abnormal in the fundi.

A general examination, including the Wassermann test and a blood chemistry determination, gave entirely negative results. One year later the condition had changed little, the hemorrhage near the left fovea being almost entirely replaced by an organized mass. The accompanying illustration was painted at this time.

ETIOLOGY

Two principal phases of the etiology await elucidation: 1. Is this condition secondary to a process elsewhere in the body? The occurrence of tuberculosis in a few cases (Fleischer's [4] two cases and others) is regarded by Fleischer as significant, but the association is a rarity, the majority of the cases showing no signs of an acid-fast infection and several even presenting a negative tuberculin test. A positive Wassermann reaction and other signs of a syphilitic infection are almost entirely lacking. A great variety of other conditions have been found in patients

having this fundus picture, but there is no constancy in their occurrence. Griscom [7] thought that the lesions of the skin (chloasma?) noted in his case might have the same cause as the lesion of the fundus. Many local complications are present, but here, again, the association seems to be only incidental.

2. What factor determines the onset and progression of the condition and how does it act? The suggestion has frequently been made that the streaks as such are congenital, the occurrence of this condition in four pairs of brothers and sisters seemingly lending some support to this contention. However, there is no instance in which this process has been found in two generations.

Violent trauma is the most frequent etiologic factor mentioned, though some underlying general factor is almost certainly present, as the condition is constantly bilateral (except in an early case reported by Walser [8]).

PATHOLOGY

Since no specimen of this type of angioid streaks has come to microscopic section, ideas in regard to the pathologic process must be adduced from careful clinical examination with the ophthalmoscope and the slit-lamp (as adapted by Koeppe for examination of the fundus with the mirror and contact glass). Lister's [9] report of pigmentation found in the retina is inconclusive, as no record of an ophthalmoscopic examination made during life is available. The same may be said of Verhoeff's [2] recently reported case. In the latter instance the eye was enucleated and a series of pigmented folds were found which, on ophthalmoscopic examination, would have appeared as lying deep in the retinal layers, with possibly the underlying vessels visible in places. This would, in all probability, correspond with the first type previously mentioned. The fellow eye, examined subsequently, failed to show any anomaly that could be compared to the condition being presented; however, a lesion was found near the disk.

This disease has brought forth much discussion and many hypotheses in explanation of the various phenomena observed.

In regard to the depth of the streaks, some place them in the deeper retinal layers (Oeller,[10] von Schrader,[11] Zentmayer,[12] Lindner [3] and Bayer [13]), and others in the region of the pigment epithelium

7. Griscom, M.: Am. J. Ophth. **2**:3 (Feb.) 1928.
8. Walser, B.: Arch. Ophth. **25**:365, 1895; Arch. f. Augenh. **30**:345, 1895.
9. Lister: Ophth. Rev. **22**:151, 1913.
10. Oeller, H. J.: Atlas of Rare Ophthalmoscopic Conditions, 1903.
11. Von Schrader: Ztschr. f. Augenh. **16**:81, 1906.
12. Zentmayer, W.: Ann. Ophth., October, 1909.
13. Bayer, H.: Klin. Monatsbl. f. Augenh. **52**:677, 1914.

(Brewerton,[14] Collins,[15] Spicer,[16] Guist,[17] Lohmann[18] and Kofler[19]). The last two authors regard the condition as fissures in the lamina basalis. After examination with the Gullstrand ophthalmoscope, Fleischer came to the conclusion that the streaks change their position, becoming more superficial as they pass toward the equator.

Because of the distribution and manner of branching and the fact that portions of the streaks are red, the suggestions have been made that: (1) they are connected in some way with the circulus arteriosus nervi optici (circle of Zinn) and its ramifications (Coppez,[20] Collins[21] and others); (2) they represent a supernumerary system of blood vessels the walls of which are for the most part pigmented (Oeller,[10] von Schrader,[11] Zentmayer[12] and others), and (3) they are fractures in the deeper layers of the retina, pigment epithelium or lamina vitrea of the choroid.

The facts that no connection has been noted with cilioretinal vessels which are, however, frequently present, and that the peripapillary ring is frequently continuous with the pigment at the margin of the disk rather mitigate against the first hypothesis already mentioned. Spicer's[16] case definitely showed that the streaks do not represent a patent system of blood vessels, as one of the streaks was interrupted by an area of complete choroidal atrophy about twice the diameter of the pigmented striation on either side of it, through which the sclera was visible, there being no connection between the proximal and the distal portions of the streak.

The third suggestion already mentioned, that the fissures occur in the pigment epithelium, in some places extend more deeply into the lamina vitrea and thereby cause a solution in the continuity of the choriocapillaris, giving rise to the hemorrhages frequently noted, seems to me to be the most reasonable. Lohmann[18] and Kofler[19] have also elaborated on the fissure theory, maintaining that the fissures occur in the lamina basalis.

Most of the earlier authors believed the reddish portions of the streaks to be due to extravasated blood, the darker portions being where the hemoglobin had disintegrated with the formation of hemosiderin and hematoidin. Dunn,[22] in 1897, and several others (Wildi,[23]

14. Brewerton, E.: Proc. Roy. Soc. Med., Sect. Ophth. **12:** 33, 1919.
15. Collins, E. T.: Tr. Ophth. Soc. U. Kingdom, April, 1923.
16. Spicer, W. T. Holmes: Proc. Roy. Soc. Med., Sect. Ophth. **8:** 33, 1914.
17. Guist: Ztschr. f. Augenh. **45:** 61, 1921.
18. Lohmann, W.: Arch. f. Augenh., 1922, vol. 90, p. 203.
19. Kofler: Arch. f. Augenh. **82:** 134, 1917.
20. Coppez, H.: Arch. d'opht. **28:** 453, 1908.
21. Collins, E. T.: Am. J. Ophth. **6:** 587, 1923.
22. Dunn, J.: Arch. Ophth. **26:** 388, 1897.
23. Wildi, G.: Klin. Monatschr. f. Augenh. **76:** 177, 1926.

Lohmann [18] and others) later came to the conclusion that the red portions represent rather large underlying superficial choroidal vessels where they cross the path of the grayish pigmentations. That this is the case is distinctly seen in the fundus here illustrated, in which the pigment epithelium below the disk is relatively poor in pigment and the choroidal markings are plainly made out.

When the eye is examined early, the general color of the streaks is usually recorded as being a reddish-brown, which changes to a grayish brown of considerably darker hue. This change in hue has been attributed to a chemical change occurring in extravasated blood with the formation of hemosiderin and hematoidin. The main objection to this explanation is the long time usually taken for this change to come about, in some cases many years (Coppez [24]). A more plausible explanation seems to me to be that the change in color is due to migration of pigment cells into the fissure as an attempt on the part of nature to bridge over the interval. This process ultimately goes on to the formation of connective tissue in the cracks, thereby obscuring the streaks.

In fully developed forms of the condition, a whitish border to some of the streaks is almost constantly found, usually on the juxtafoveal side; this may vary, even occurring on both sides in some instances (Zentmayer [12] and Oeller [10]). The most widely accepted view is that these borders represent formations of connective tissue, other suggestions being that they are due to light refraction along the edges of cracks (as seen in cracks occurring in lacquer (Lohmann [18]), or glass (Kofler [19]) or calcareous changes in the walls of an abnormal system of blood vessels (Zentmayer [25]).

Guist [17] and Leber [26] have likened the conditions found ophthalmoscopically to the disturbances seen after detachment of the choroid, as described by Fuchs.[27] Wrinkling with folds of various layers has also been suggested (in the pigment epithelium by Alt [28] and in the retina by Walser [8]).

The pigmentary changes are usually of a fine dustlike character occurring throughout the fundus, particularly in the posterior polar region, and commonly considered due to changes in the pigment epithelium. Sometimes the pigmentary changes have been so extensive as to suggest a true chorioretinitis, usually in the periphery. In the majority of instances the periphery has been reported normal, and this has been borne out by the lack of changes in the limits of the fields of vision.

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24. Coppez, H., and Danis, M.: Bull. Soc. belge d'opht. **48**: 57, 1923.
25. Zentmayer, W.: Tr. Am. Ophth. Soc. **12**: 266, 1909.
26. Leber, in Graefe-Saemisch: Handbuch der Gesamten Augenheilkunde, 1915.
27. Fuchs, E.: Klin. Monatsbl. f. Augenh. **60**: 767, 1918.
28. Alt, A.: Am. J. Ophth. **26**:171 (June) 1909.

The macular degenerative process is the most serious aspect of the disease, vision being grossly unimpaired until it sets in. After a time, the process apparently interferes with the nutrition of the retina in the region of the macula, since a degenerative process is present. This passes on to an exudative type likened by Coppez [24] to the exudative senile macular retinitis which he fully described.[29] Hemorrhages are of frequent occurrence in the macular region. I take this to be due to the fact that the layers are more closely applied in this region and that a fissure in the pigment epithelium is more likely to involve the underlying choriocapillaris. No superficial retinal hemorrhages occur in this condition. Collins [21] thought that the streaks represent extension of blood between the retina and the choroid from choroidal hemorrhages. I rather think that the hemorrhages are secondary.

COURSE AND PROGNOSIS

Angioid streaks in the fundus oculi is a slowly progressive disease which may, however, remain stationary for years. The ultimate prognosis concerning central vision is poor. It may be suddenly abolished by a hemorrhage in the macular region or it may be interfered with at a late stage by the progress of the degenerative process in the macular region and in the surrounding retina.

Coppez' [30] case is of special interest as it represents one showing a typical course, the patient being observed over a period of twenty-five years. When he first saw the woman in 1900 he thought that the condition was one of an abnormal peripapillary vascular system with short prolongations radiating from it, probably in connection with the circulus arteriosus nervi optici (Zinn). No change took place for eight years, and he reported the case [20] as a vascular anomaly in 1908. At that time, there was normal vision in each eye. Nine years later, however, macular degeneration had set in with reduction of vision and the formation of a central scotoma in the right eye, followed by a similar process in the left eye. The streaks had changed during this interval from a reddish color to a dark brown and had become more extensive. By 1923, general retinal degeneration was evident, the streaks still being present but partially obscured.

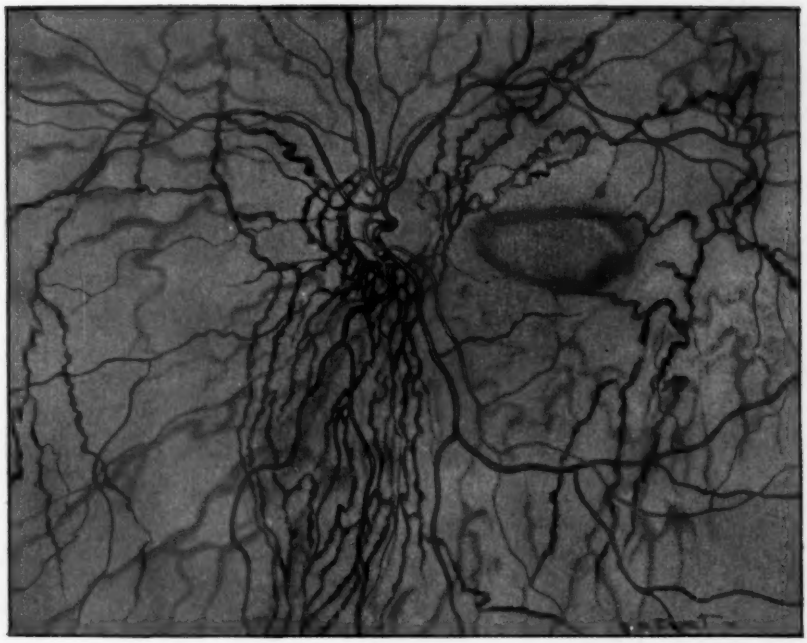
SYMPTOMS AND TREATMENT

During the period when the only manifestation present is the pigmented striations in the fundi, there are usually no symptoms. As a precursor of observable macular changes, distortion of objects may occur (Wildi [23] and Calhoun [31]). Central vision may at any time

29. Coppez, H., and Danis, M.: Bull. Soc. belge d'ophth. **46:** 44, 1922.

30. Coppez, H., and Danis, M.: Soc. franç. d'ophth., 1925, p. 560; Arch. d'ophth. **42:** 649, 1925.

31. Calhoun, P.: Am. J. Ophth. **2:** 3 (Feb.) 1928.



Angioid streaks of the retina. The streaks are all subjacent to the retinal blood vessels. A partially absorbed subretinal hemorrhage is present in the foveal region.

become suddenly abolished by a hemorrhage or gradually reduced by the posterior polar retinitis. Peripheral vision is usually little affected.

Potassium iodide is given to aid the absorption of hemorrhages if they are present. If my conception of the mechanism of the production of the streaks is correct, the slightest pressure or trauma (any factor which might increase the centripetal pressure from the vitreous on the pigment epithelium) should be zealously avoided.

CONCLUSIONS

The hypothesis that most satisfactorily explains the various features of these cases is that the basis of the condition is a (congenital?) deficiency in the pigment epithelium favoring the formation of fissures in it due to a gradual or intermittent pressure from within. The latter may be a result either of the natural growth of the vitreous or of repeated minor traumatisms (rubbing the eyes, etc.).

1. The streaks first appear in the posterior polar region, where any force from the front would, by contrecoup, have its greatest effect. Stretching of the coats of the eye is most frequently found in this part.

2. Early in the course of the disease, the streaks are a dark red, possibly due to the choroidal pigment showing through the undisturbed choriocapillaris. Later, as the pigment cells tend to migrate into the fissure (representing an abortive attempt to bridge over the deficiency), the streaks become darker and more grayish. At a much later stage, this color becomes lighter, as connective tissue forms in the rents, obscuring the underlying pigment.

3. One of the strongest points in favor of the foregoing hypothesis is the arrangement of the reddish portions in relation to the underlying choroidal network where this is visible (as in a large area below the disk in the illustration). Here it is observed that the area in which a visible choroidal vessel intersects the path of a streak is distinctly red, in contrast to the adjacent grayish color.

4. The margins of the streaks are not smooth but are characterized by minute irregular serrations, as though the tear had advanced gradually.

5. The whitish border sometimes seen, which is usually narrow but occasionally is extensive, is most satisfactorily explained by the assumption that it is connective tissue resulting from the disruption of the tissue.

6. The depth of the pigment streaks as measured with the slit-lamp corresponds to the choroid.

7. The manner of branching can easily be due to mechanical considerations and lines of least resistance. These are too complex to permit of further elucidation here. The streaks are wider near the posterior pole and narrower near their extremities.

8. The tendency to hemorrhages, which occur particularly in the posterior polar region, is easily explained by the close approximation of the pigment epithelium and the subjacent lamina vitrea and choriocapillaris in this region. If the rent occurring in the pigment epithelium is wide enough, it would tend to tear the contiguous lamina vitrea with its underlying layer of elastic tissue and choriocapillaris, thereby producing a choroidal hemorrhage. In uncomplicated cases, the hemorrhages are never extensive or superficial in the retina.

9. The retinal degeneration starts in the mascular region in which the retina is most dependent on the contiguous choroidal circulation for its nutrition.

10. The fine dustlike pigment changes so commonly reported in this type of case are almost unanimously attributed to changes in the pigment epithelium.

PERIPHERAL IRIDECTOMY IN EXTRACTION OF CATARACT *

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Peripheral iridectomy is no new step in the extraction of cataract. I have little to add to the knowledge of this procedure, but I hope that a recital of the history of the operation and the presentation of the views of some of the masters of ophthalmology, past and present, who have practiced this procedure, may prove of sufficient interest to arouse a discussion as to its value. Few physicians can claim to be free from bias, and when they find a particular method of value they are apt to try to persuade others to their way of thinking. The extraction of cataract combined with a small peripheral iridectomy in my own experience has resulted in such beautiful and perfectly functioning eyes that I plead guilty to the charge of prejudice in its favor.

REVIEW OF THE LITERATURE

The first record of peripheral iridectomy is that of Beer about 1800, who recommended the excision of the iris without injury to the sphincter when the latter adhered to the capsule of the lens. The removal of adherent iris was much feared at that time. Beer, however, did not employ the operation in connection with the extraction of cataract.

In 1871, Pope [1] of New Orleans published an article concerning iridectomy without cutting the sphincter pupillae. He had performed the operation six times for such conditions as central corneal opacity and adherent leukoma. He likewise did not employ this form of iridectomy in the extraction of cataract.

The first surgeon to perform peripheral iridectomy in connection with the extraction of cataract was C. Bell Taylor,[2] surgeon at the Nottingham and Midland Eye Infirmary, who published his report in 1871. He began his paper by saying that on former occasions he had presented the technic of the operation in the *Lancet*, the *Ophthalmic Hospital Reports* and the *Ophthalmic Review*. His first description, therefore, must antedate 1871. There appears to be some question as

* Submitted for publication, Jan. 18, 1929.

* Read at a meeting of the Section on Ophthalmology of the New York Academy of Medicine, Nov. 21, 1928.

1. Pope, B. A.: Iridectomy Without Cutting the Sphincter, Arch. f. Augenh. **2**:192, 1871.

2. Taylor, C. Bell: Lancet **2**:634 and 802, 1871.

to the exact technic of Taylor's procedure, some authors affirming that he did not perform an iridectomy but a large iridotomy. That he actually performed an iridectomy is evident from a reading of the paper referred to in which he said, after describing the preliminary steps:

> The upper segment of the iris is then seized and a small piece of the periphery only excised, the pupillary margin and portion of iris attached to it being left untouched and free in the anterior chamber; the lens is then extruded through the gap in the ordinary way, gliding behind the pupil so that there is no stretching of the sphincter.

The reason for the uncertainty as to Taylor's technic is probably to be found in a later issue of the *Lancet* in which, in answer to a criticism by Wolfe, he detailed a somewhat different method. To quote him again literally:

> With a very fine pair of iris forceps seize the iris a little to the peripheral side of a point midway between the periphery and pupillary margin; pinch up a minute piece, lifting it just enough to enable the operator to make a small aperture in the membrane. The corneal wound must now be enlarged to the right and to the left and the iris separated from its ciliary attachment to a similar extent by a fine pair of blunt pointed scissors, one point of which is inserted into the aperture already made.

The method first described is that which is known as peripheral iridectomy, while the latter appears to be a long incision into the iris and an iridodyalisis.

Certain it is that Taylor did not make a great impression on the practice of surgical treatment for cataract, and his method fell into disuse for many years. The operation was next mentioned in 1890, when Chandler [3] of Boston, who was evidently not familiar with Taylor's work, published a report of fifty cataract extractions by a new method. In this paper, he described the iridectomy as preceding the extraction of cataract. In 1904, Chandler [4] published a report of 312 cases of cataract extraction with a small peripheral button-hole in the iris. In this article, he said: "I have usually made the opening after I have extracted the lens, as it has seemed that the small amount of aqueous under the iris acts as a buffer and facilitates its removal."

The performance of the iridectomy following removal of the lens was a great step forward over that preceding extraction, but the credit belongs to Pflüger [5] of Berne, who in 1897 read a paper before the International Congress at Moscow on iris prolapse and its prevention.

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3. Chandler, H. B.: Report of Fifty Cataract Extractions by a New Method, Boston M. & S. J. **123**:365, 1890.

4. Chandler, H. B.: A Report of 312 Cases of Cataract Extraction with a Small Peripheral Button-Hole in the Iris, Arch. Ophth. **33**:1, 1904.

5. Pflüger: Iris Prolapse and Its Prevention, Klin. Monatsbl. f. Augenh. **26**:339, 1897.

In this article, he advocated the performance of iridectomy following removal of the lens. This is the generally accepted practice among those surgeons who do the button-hole iridectomy today.

In 1909, Hess [6] reported his experience with the operation in 1,000 cases, and as a result of his teachings the operation of peripheral iridectomy is generally known in Europe as the Hess operation, although it is apparent that he is not its originator.

PREFERRED METHOD OF OPERATION

The question may well be asked: Why was the peripheral iridectomy first proposed, and what reason is there for preferring this method to the simple extraction or the usual combined operation of today? Time and experience seem to have definitely settled the question, once so seriously debated, as to whether the simple or the combined operation is the more generally successful. The almost universal opinion prevails that combined extraction is the safer method for routine use. Freed of its dangers, however, it is safe to say that all ophthalmic surgeons would prefer to do the simple rather than the combined extraction. The normal appearance of the eye so operated on, with its round, central and mobile pupil, together with better functional results in those cases in which healing occurs without mishap, represent the operation of cataract extraction well nigh at its best.

The advocates of peripheral iridectomy claim, and I think justly, that it offers the advantages of the combined extraction without the dangers of the simple operation. As Taylor so nicely expressed it:

> Every modern improved method of extraction, whether it be Graefe's, Mooren's, or Pagenstecher's involves the sacrifice of a portion of the iris extending from the periphery to the pupillary margin and the one thing more to be desired is, that with the same safety and facility of performance we should be able to secure for our patients that highest indication of success, a central and movable pupil.

What are the advantages and disadvantages of peripheral iridectomy? In a critical mood I shall first review the disadvantages. In a rather careful search of the literature, I found only two authors who mentioned disadvantages. This, of course, does not mean that there are none, but rather that the articles pertaining to this operation have been written by those who are more or less enthusiastic advocates. Pascheff [7] mentioned two disadvantages: the danger of incising the capsule at the same time that the iris is cut and the fact that too great pressure might rupture the zonule of the lens and allow vitreous to present. Experience shows that these dangers are of no great moment, particularly as the iridectomy is performed at the end of the operation.

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6. Hess: Ztschr. f. Augenh. **18**:21, 1907.
7. Pascheff, C.: Ann. d'ocul. **151**:424, 1914.

The second disadvantage credited to Pascheff is that the operation is more difficult if the iris is adherent, if the nucleus is large and if the sphincter is rigid. These objections appear to be valid and represent the type of cataract in which complete iridectomy is best performed. DeWecker, who was justly famed as a brilliant operator said, "This is a difficult technic and one rarely succeeds in it." This is probably because of the lack of proper instruments for grasping the iris and imperfect anesthesia, for in discussing the advantages of the operation Pascheff stated first of all that it is the easiest to do of any operation on the iris. In fairness, it must be admitted that it is more difficult to grasp and draw out a small portion of the iris than to do a broad iridectomy. This, however, does not seem to be a real objection, but rather one of the satisfactions of a refined technic. The third disadvantage is one which would naturally come to mind readily, and that is the fact of having two openings in the iris. The fear of monocular diplopia has been called up by several writers. In the observation of men of wide experience and in my own small experience this does not occur, due largely, no doubt, to the peripheral location of the opening.

I shall now consider the advantages of successfully executed peripheral iridectomy. There is first, but by no means the most important, the cosmetic appearance. If the iridectomy is small and placed well toward the limbus, it is entirely covered by the upper lid and will be noticed only by a trained colleague. In 1927, Tennent [8] stated that most patients do not mind the disfigurement of a large coloboma, but he somewhat sarcastically added that occasionally it meets with objection to what certain fastidious Americans call "the inverted key-hole." The second advantage of the round pupil is the contraction in convergence which is probably of value only through its action of stopping out the periphery of the lens. Since the lens is removed, this function is of little value. The reaction to light is, however, of real value, as it enables the eye to adapt itself to variations in intensity of illumination. The wide coloboma of the combined operation exposes the eye to too great light and results in dazzling; in addition, it makes the astigmatism present more troublesome.

Pflüger [5] was most impressed by the fact that he had never seen glaucoma follow a simple extraction, and in his hands the same was true of peripheral iridectomy. This he explained as a result of the partial excision of the dilator fibers, combined with the hole in the iris.

One of the greatest advantages of the peripheral iridectomy lies in the prevention of prolapse of the iris. In 600 operations performed by Hess, prolapse of the iris occurred in only 0.66 per cent. The small opening near the limbus provides an adequate safety valve for the

8. Tennent, J. N.: Lancet **2**:1174, 1927.

exit of aqueous in case of sudden opening of the wound. Hudson [9] gave the figures of prolapse of the iris in simple extraction as reported in the literature as follows: Marshall, 13.86 per cent; deWecker, from 3 to 4 per cent; Hesse and Schweigger, 8 per cent; Haessig, 7.9 per cent; Elschnig, 4.7 per cent. Chandler, in 312 cases of peripheral iridectomy saw prolapse of the iris only four times, two of which were the direct result of violence. Barkan,[10] in reporting on Meller's experience, quoted 180 cases, with two prolapses of the iris, while he had two in forty-six done by a combined operation.

No statistics are available concerning the frequency of incarceration of one or both pillars of the coloboma, but every ophthalmologist knows that this is not infrequent in combined extraction. In 1911, Pagenstecher [11] reported fifty cases without a single prolapse of the iris and saw no bleeding from the iris, rupture of the hyaloid, vitreous loss or other mishap. Pagenstecher, therefore, attempted a simple extraction, and did the peripheral iridectomy only if the patient was unruly, the sphincter failed to contract or the iris prolapsed.

A further advantage of peripheral iridectomy lies in the fact that there is little likelihood that tags of capsule will become entangled in the section, owing to the retention of the sphincter and to the size and location of the iridectomy. Lens capsule incarcerated in the wound is resistant to absorption and is slow to organize. Firm cicatrization of the wound is delayed, and the eye is rendered more liable to immediate or late infection. Tennent [8] believed that the most important advantage of peripheral over total iridectomy is that it entails less risk of incarceration of tags of the capsule of the lens. Hudson [9] stated that remnants of capsule tend to draw the ciliary processes forward, narrowing the anterior chamber and leading to glaucoma, and, furthermore, that detachment of the retina may result from the pull of the capsular bands. Lastly, the excision of a piece of iris after the extraction of the lens prevents bleeding into the anterior chamber from the cut iris, at least until its presence is less annoying. Loss of vitreous is less frequent, as the iris is intact until the final step of the operation.

Barkan [10] and Tennent [8] observed that corneal astigmatism is less troublesome with the small iridectomy than is the case with a large coloboma. Taylor,[2] the originator of peripheral iridectomy, remarked that he thought the astigmatism was less in amount, while Pflüger [5] and Hess [6] both stated definitely that this is true. In averaging the amount of astigmatism in fifty combined extractions and in fifty cases

9. Hudson, A. C.: Roy. London Ophth. Hosp. Rep. **19**:84, 1913.

10. Barkan, Hans: Cataract Extraction Performed by Prof. Josef Meller of Vienna, 1919-1921; Review of 249 Operations, J. A. M. A. **81**:2086 (Dec. 22) 1923.

11. Pagenstecher, A. H.: Arch. f. Augenh. **69**:251, 1911.

of peripheral iridectomy in my practice, I found that the former figure was 2.6 and the latter 2.12 diopters, practically 0.5 diopter less in the latter case.

MODIFICATIONS

Various modifications of the peripheral iridectomy have been suggested and need be mentioned only casually.

Schweigger [12] made his section downward and then did a peripheral iridotomy with a double-edged knife. He instilled eserine to enlarge the opening.

Kuhnt [13] resorted to incision of the iris with a needle or cystotome only after an unsuccessful attempt to produce an iridodyalisis. At times, he employed a small curved hook to draw the sphincter away from the lens, when the latter did not pass through the pupil readily. This would seem to be a useful procedure.

Bajardi [14] made a large peripheral incision into the iris, through which he expelled the cortex of the lens. The base of the iris was punctured by deWecker's blunt-pointed scissors immediately after the corneal incision had been made and the opening was enlarged after the nucleus had been delivered through the pupil.

In 1906, Verhoeff suggested making a small round iridectomy near the root of the iris and then introducing deWecker's scissors, cutting straight down to the sphincter.

In a clinical lecture on methods of cataract extraction, Parsons [15] discussed the peripheral iridectomy as being especially applicable when simple extraction is attempted but the iris prolapses. It is interesting to note that after saying "it has even been suggested that this iridectomy should always be affected deliberately," he went on to point out its many advantages. He concluded by saying, "I can confirm the advantages of this method from personal experience and I feel strongly that it is worthy of more extended use than it has hitherto had."

Nida [16] of Paris, writing in 1927, stated that because of the disadvantages of the combined extraction, the peripheral iridectomy was done in all cases in his clinic.

Dr. Leo L. Mayer, in giving his impressions of European eye clinics in 1928, said that in the Vienna clinic "iridectomy follows extraction of the lens and is for the most part peripheral," and that at the Hotel Lariboisière, Professor Morax leaves a conjunctival bridge after the incision and does a peripheral iridectomy following the extraction of the lens.

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12. Schweigger: Arch. f. Augenh. **13**:103, 1898.
13. Kuhnt: Ztschr. f. Augenh. **13**:103, 1905.
14. Bajardi, P.: Gior. d. r. Accad. di med. di Torino **58**:243, 1895.
15. Parsons, J. H.: Lancet **2**:129, 1909.
16. Nida, Marcel: Am. J. Ophth. **10**:684, 1927.

McLean,[17] in describing Barraquer's technic in the intracapsular operation, said that the iris forceps and scissors are introduced at the tip of the wound above, and that the smallest possible peripheral iridectomy is made without bringing the iris out of the wound.

My experience in extraction of cataract with the excision of a small portion of iris near the periphery is limited to something over fifty cases, and in this small series I have had one prolapse of the iris and one case with a small incarceration in the wound which merely elongated the pupil vertically.

In the operation as I perform it, a single silk suture is introduced about 5 mm. above the upper corneal margin, a section with a generous flap is made, the anterior capsule is removed with forceps as freely as possible, and the lens is expressed. A small peripheral iridectomy, using Hess' special iris forceps, is then performed. The suture is tied and the anterior chamber irrigated with physiologic solution of sodium chloride. Atropine should always be instilled; the use of eserine is undesirable, as it favors the formation of posterior synechiae. With this technic, I believe there will be almost as many cases of 6/5 vision as when any intracapsular method is used, and fewer complete failures.

Extraction with peripheral iridectomy more completely fulfils the physiologic requirements of a good operation than one which mutilates the eye by the removal of a portion of the sphincter of the iris. I can do no better than to quote from the admirable lecture delivered last spring to this academy by Dr. Walton Martin on the future of surgery:

> One may say that thirty years ago a surgeon was concerned with the anatomical consideration of whether he could remove a given tumor. Today, having mastered the technical difficulties, he is concerned with the question as to how much he accomplishes with a given mutilation.—The surgery of yesterday was dominated by anatomy, the surgery of today is dominated by physiology, and the surgery of tomorrow will be more so.

17. McLean, William: My Experience with Dr. Barraquer in Barcelona, Arch. Ophth. **52**:460 (Sept.) 1923.

MUCOCELE OF THE POSTERIOR ETHMOID SINUS WITH ORBITAL SYMPTOMS

REPORT OF A CASE *

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C. H., a man, aged 41, had suffered from gradual bulging of the right eye for some time, with drooping of the right upper lid. On May 23, 1928, the vision in the right eye was 20/30; he complained of periodic obscurations. The right eye was displaced forward with a widening of the palpebral fissure; it measured 12 mm., while the left measured 11 mm. This seemed to be due to a retraction of the lower lid. There was a definite paresis of the right external rectus and of the right superior rectus. The pupils were 4 mm. each. The prominence of the right eye measured 26 as compared to 20 on the left side. Palpation within the orbital margin was negative. The fundus showed papilledema (2 diopters), with a small hemorrhage in the retina above. The field was contracted down and out, and the blind spot was definitely enlarged. The left eye was normal.

Roentgen examination showed definite cloudiness of the right ethmoid region, and the line between it and the orbit had almost disappeared. The left side seemed normal. Another report stated that the entire right orbit was cloudy, its inner wall seemed to be destroyed and the entire right ethmoid region was cloudy. This was interpreted as an involvement of the right ethmoid with breaking through into the orbit. The optic canal was normal. The ophthalmoscopic changes, the muscular involvement and the defect in the visual field suggested a lesion in the deeper part of the orbit. The symptoms in the orbit did not seem severe enough to be caused by a primary orbital process with secondary involvement of the sinus.

The patient was referred to Dr. J. W. Babcock, who previously had had him under treatment. Dr. Babcock reported that there had been a slight involvement of the right antrum. The nasal examination, in other words, did not throw any light on the orbital condition. The antrum was treated without causing any change in the eye.

Dr. C. G. Coakley, who saw the patient in consultation, could not decide whether the process was more in the orbit or in the ethmoid, and advised an orbital exploration. Before doing this, it seemed to me that further information could be easily obtained by a simple exploration from the nose; this was done by Dr. Babcock on June 25. After removing the middle turbinal, an opening was made into the posterior ethmoid sinus, and a large cavity was entered. A considerable quantity of thin, syrupy material escaped, which, Dr. Babcock said, resembled Hollandaise sauce. The fluid contained a large number of cholesterol crystals. A large opening was made into the cyst, and the contents were emptied by suction. On escape of this material, the patient immediately complained of diplopia, and the eye manifestly receded. Examination with the red glass showed a double image down and to the right, while the motility of the right superior rectus was improved. The bulging of the eye had been reduced 3 mm. The swelling of the nerve head was unchanged. Subsequent treatment consisted in irrigations, and the discharge rapidly ceased. On June 27, the patient was much improved. There was diplopia only in the extreme right field. The bulging of the eye was now only

* Submitted for publication, Feb. 18, 1929.

1 mm. The swelling of the nerve head had been reduced to 1 diopter. The orbital process rapidly disappeared, and the nose was dry after one week. The recovery has continued, and on recent reexamination, Jan. 18, 1929, vision was normal; there was no diplopia and no exophthalmos. The nerve head was normal except for slight blurring of the margin.

The soft tissues removed at the nasal operation were examined by Dr. William C. Clarke, who reported that the mucosa was intact over the specimen. In the depths, the mucous glands were hyperplastic. There was no evidence of neoplasm, but rather an extensive inflammation. The smears showed extensive cholesterin plates. Section of bone showed rather degenerated trabeculae with fibrosis of the supporting soft parts without cellular infiltration.

COMMENT

The nature of the nasal condition is unusual. Cystic distention with pressure in the orbit, the cyst containing a thick, syrupy fluid, suggests a mucocele. The mucoceles which I have seen have usually been a combination of ethmoid and frontal sinuses which has produced a large tumor, easily felt at the inner and upper orbital margin with resultant displacement of the eye. A mucocele has rarely originated from the cells of the posterior ethmoid labyrinth.

A very important reference in this connection is that by van der Hoeve on "Mucocele der Keilbeinhöhle und hinteren Siebbeinzellen mit Atrophie der Sehnerven."[1] This article is based on the report of a case in a patient, aged 51, who had had a protrusion of one eye with optic atrophy. There was a negative nasal condition, and the roentgenogram showed a shadow in the depth of the orbit. The orbit was explored, and an incision was made along the temporal margin; the palpating finger detected a bony resistance at the inner wall close to the optic foramen, suggestive of a distention of the ethmoid caused by a thin, bony wall bulging into the orbit. The diagnosis was then suggested of a pneumatocele of the posterior nasal sinuses. The ethmoid sinuses were opened from the nose. As soon as the instrument entered the ethmoid, from between 20 to 40 cc. of brownish-green, tenacious mucoid fluid escaped. The fluid was without odor and contained many cholesterol crystals. When the cavity was probed, it seemed to communicate with the sphenoid. The result of the operation was satisfactory, and the patient recovered except for the optic atrophy. In the literature, van der Hoeve states that he found eight previously reported cases, which he reports in brief, and the entire subject is carefully presented.

The condition begins early in youth, probably in the beginning of the second decade, and the progress is very slow. A striking observation is that the nasal symptoms are extremely slight. Headache is a fre-

1. Van der Hoeve: Mucocele der Keilbeinhahle, Ztschr. f. Augenh. **43**:223, 1920.

quent symptom. The orbital symptoms are always well marked and consist in exophthalmos, disturbances of ocular motility and changes in the nerve head and field. Inflammatory symptoms in the tissue removed at operation have usually been absent. The fluid varies from a clear and watery one to a brownish yellow, thick material. In most cases, cholesterol was present in large quantities. Van der Hoeve said that the diagnosis is obscure, and in no case has it been made before operation.

THE NEW INTRACAPSULAR OPERATION FOR CATARACT EXTRACTION *

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Glancing backward over that history of the intra-capsular extraction of cataract which begins with its intensive presentment by Col. Henry Smith in 1905, those who were fortunate enough, through his tuition, to become assured of its scientific superiority have every reason to be encouraged. Out of antagonism and frigidity have grown interest and warmth. The entire ophthalmologic world has one way or another turned its effort to obtain in ophthalmology that ideal of all surgery, a complete operation. By many and often devious routes, enemies have become friends. One by one, the claims advanced by Colonel Smith have outlived the objectors and become commonplace. It is obviously true that the safely completed intracapsular extraction is incomparably superior to any other.

Ophthalmologists are not in accord as to detail or as to the influence of general physical conditions. There are still those who emphasize preparation, dressings and a myriad of particular and peculiar instruments. There are many theories as to the reason for prolapse of the iris and its prevention, the toxic danger of neglected lens matter or its harmless absorption, and the danger of tension, intra-ocular or systemic, and all have their sincere supporters. But such factors will always attract study, seek solution or be periodically forgotten.

My own position on most of these questions rests on the assumption that a senile cataract is naturally found in a senile eye, that therefore changes in tissues are to be expected, and that normal results should not necessarily follow. The everlasting sameness of results from varied operative measures cannot be otherwise explained. Apparently normal function is no index of normal tissue.

So we find fluid vitreous, irresponsive corneas, indolent circulation of blood and lymph, and nonresilient, hemorrhagic or fragile irises, all quite unsuspected. Any attack on the integrity of the senile lens, part or whole, may prove ill advised, unfortunate or fatal, and much that is attributed to surgeon or method is, to my mind, altogether inevitable, once continuity of part or habit is broken. So far as operations may relieve conditions, therefore, the surgeon is justified, and postoperative theorizing will not advance skill. This opinion has at least one value: Every little adverse happening does not denote fault in skill or method or attack the operator's judgment.

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* Read before the Ophthalmic Section of the New York Academy of Medicine, Dec. 16, 1928.

Notwithstanding all differences, however, the main road today is toward the safe intracapsular procedure. Safety is to be sought always. "If you can establish a safe method," Herman Knapp wrote to Colonel Smith, thirty years ago; but one must ask, what is the measure of safety—the operation or the final result? The correctly completed safe operation should insure a safe and speedy convalescence. One notes that the brief operation is often agonizingly long, and the simple procedure sadly incomplete.

Does it not seem that the selection of a method should be preceded by a study of the subject to be operated on as well as of the object sought? There are certain axiomatic relations and inherent qualities of tissue. The operative attack is safe as it obeys or neglects them, and a method cannot be more perfect than the matter which it affects.

I cannot conceive the state of mind that expects one method to be universally applicable. Not even in my first enthusiasm could I agree with Colonel Smith on this point. Indeed, grapes and plums show as frequent and curious differences in texture and condition as do the eyes of animals or human beings. Then, consider technical variability. "All sufficient" is not a value in the argument for any remedy or operation, since selective judgment is based on analysis. If careful examination precedes operation, it must precede selection of method. Good surgeons vary their procedure even in classic forms. Practice of one method does, of course, lend skill, and skill gradually increases the possibilities to a splendid precision.

I suggest, however, that once this precision is attained, it may become the enemy of change. Few men could imitate Herman Knapp in leaving his mastery of the combined operation and taking up the simple procedure as his routine, yet this is what progress demands of all operators.

Ophthalmologists must possess a sufficient inherent something, integrity or rectitude, to keep them everlastingly awake to the failures, the unsatisfactory cases and those that just escape failure. They must be quick to remember, even if they do not report, the prolonged, discouraging convalescences that conclude with so much less vision than the safe operation promised. They must strive to retain their patients, to face them and suffer them rather than to be glad of their escape. If ophthalmologists succeed in this they will never regard a single method as all sufficient.

It is thus that I find my own antitheses. I believe in a clear corneal section, but for peripheral iridectomy I must do the sclerocorneal. I believe in peripheral iridectomy, but I much prefer the simple operation if the iris is healthily bright and resilient. I have always agreed with Terrien that the simple operation is the one of choice; the combined,

that of necessity. I always try dislocation from without, but if it halts, I use the Kalt forceps, remembering that though tissue toughens with age, it also deteriorates.

It is, I believe, just this state of mind which is driving the ophthalmologic world away from the dangers of mere safety into the safety of avoidable dangers.

THE AMENDED OPERATION

The first advised change from the old method is that of the section. This should be peripheral, in the sclerocorneal margin just beyond the clear cornea and just outside the sclera. I know no source for enlightenment on the subject of the section which can compare with Colonel Smith's book. I believe that the clear corneal section has no superior, but with it one cannot make the peripheral iridectomy.

The second change is in the iridectomy. Discussions on iridectomy, its virtues and the methods of its performance, have filled volumes. I shall describe the peripheral iridectomy as performed by Dr. Kalt at the Quinze Vingt. He uses a delicate right-angled hook with which he picks up the iris in the line of his section and excises the tiny fold with a DeWecker scissors, close to the knee of the hook. The result is a peripheral window a little longer than broad, an intact pupil and, therefore, the natural protection of the iris for lens and zonula. Neither the corneal stitch, which he always uses, nor the conjunctival flap, which he never uses, interferes. Attention might be called to Colonel Smith's description of conjunctival flaps.

The third change is in the dislocation. Here there has always been the fear of pressure. There is an analysis of the question by Dr. James Smith. Fitted for the task mathematically, as well by operative skill and experience, he has concluded this procedure for those equally well equipped. Dislocation requires force. If the lens is detached below and its attachment above is kept intact, it will be extracted lower edge first. To fail in this causes the discharge of vitreous before delivery. It is conceded that the way out is difficult and dangerous. Fear of this procedure has been the barrier to its adoption. Various methods have been offered as preventive. All have been more or less useful in the hands of one operator or another in his own practice. The new way, however, eliminates need for these methods, as well as the heretofore justifiable fear of the operation.

There is a man in India named Madre Das, a Mohammedan. He knows little ophthalmology and little surgery, but he operates on cataracts cleverly and well. He has affiliation with the native societies and associations; he agitates with the agitator against the foreign physicians who use the natives for outside practice. He asks and accepts all sorts of tips, fees and praise and is not bothered by the code; hence,

the count of his cases of cataract approaches 60,000. I do not know from whom he learned his method, but he spills no vitreous.

At a certain time in the operation, when the agile East Indian seems to be working in the observer's line of vision, the lens rises swiftly as the cornea is tucked beneath it. Colonel Smith presents the hidden incident. Having made the section and iridectomy, Madre Das, with his thumb, slides the upper lid over the section and holds it there while he dislocates the lens. Rather than the thumb, the Colonel uses the broad spatula. It is malleable and can be bent at the shank if convenient. Its convex surface is held against the section while the hook dislocates the lens.

The hook is no longer applied to the cornea; instead the knee of the hook is applied to the sclera well down in the inferior fornix, the ball of the hook touching the globe behind the edge of the lens. Pressure now is made with the spatula against the cornea over the section and with the hook—both knee and ball—toward the center of the globe. Slowly the hook is advanced toward the scelorcorneal margin. The ridge of the lens is reached; the lens rises. The pressure on the hook is decreased; its ball is raised over the conjunctival roll. The spatula is removed, and the hook, continuing its course, tucks the cornea under the lens. The lens, still adherent along its upper border, is gently raked off. Speed is not indicated; the globe and its content are absolutely under control, and all progress subject to the will of the operator. It is practically impossible to dislocate the lens above or to express the vitreous in delivery.

The iris is replaced with the usual repositor in the usual way. Replacement after marginal iridectomy in intracapsular extraction has always been to me a dreaded difficulty. With the peripheral iridectomy and the replacement simplified, the drawn up pupil is unknown, and if iridectomy prevents prolapse, that at the periphery is obviously the most reasonable, mechanically.

There is one objection left: An assistant is necessary. There can be no question about the value and none about the simplicity of his part. Of course no man is better than his training, but while the old operation needed the highly trained helper, the new makes no such demand. I have called the assistant a necessity, but a substitute is complete anesthesia, for with it, some brand of speculum can be retained throughout.

I feel that the argument, that it is an incomparable advantage to have but one mind and one pair of hands responsible is only partly true. I am not so sure that an assistant brings nothing but danger. A second pair of eyes has frequently served. One thing is certain: With the lids and brow controlled, the one mind and the one pair of hands can give their undivided skill to the main business—complete extraction and an intact pupil, an assured and brief healing, and the best vision obtainable.

This paper emanates from Colonel Smith's new book and his teaching. It is a teacher's book for surgeons; refreshing, humbly minute and truthful. It is not too much to say that Colonel Smith has disproved his own assertion that operations for cataract should be performed only by those who specialize in this kind of operation, for he has placed a safe and readily acquired method in the hands of every operator.

I would not spoil my plea by preaching, but ophthalmologists are not all operators, and all operators are not equally fitted for performing all types of operations. There are joiners and cabinet makers. There is, if you like, a Michael Angelo and a Cellini. Again, there are many who have missed the foundational training in the use of instruments. A celebrated French surgeon, when he saw a corneal section made with one forward movement of the knife, a procedure that he had ridiculed, remarked, "Oh, I see, the knife does it." T. Galliard Thomas taught that the obstetrician's mind must be in the tip of his index finger. Francis Delafield said that to interpret auscultation, the eye should be inside the wall of the chest. All technical difficulties yield to practice.

Patience, normal pulse and respiration, a happy, calm assurance, a tender firmness together with facile fingers, keen vision and speed are always the high qualities, but one must remember that genius permits fantastic and clever manipulations unwise in other hands.

It would be unscientific to deny or ignore the difficulties which must be overcome. The first is the necessity of a fairly perfect section. It is impossible to make a peripheral iridectomy if the section is in clear cornea, and difficult if the section is uneven. I believe the Kalt hook is a neater tool than the forceps and its use seems less painful, but one must learn to cut beneath it. There is also the tough iris which may have to be dealt with over the lens. This is also experienced with the simple operation, and is exaggerated with the lens in capsule. These cases, however, are most comfortably completed with patience. Fisher offers a useful instrument that has a stout needle on one end and a spatula on the other. There is a short DeWecker scissors and, with short iris forceps (if forceps are used), this contributes greatly to steadiness in iridectomy. I must repeat Casey Woods' dictum, "I cannot see the value of long handled eye instruments."

In dislocation of the lens, one has to learn to use both hands cooperatively. This is carefully detailed by Colonel Smith. I have not found the dislocation of the lens always visibly apparent. If the cornea does not bend under easily, one may repeat the maneuver of dislocation.

There are so many lid holders and retractors, that, as with all instruments, the preference seems personal. There are, however, definite needs according as one hopes to fill the assistant's place or to safe-

guard the assistant. Green's right and left retractor will control the most intractable lids, but it may interfere with dislocation, and one must be wise in its removal. Fisher's hooks are excellent. Smith's speculum is ideal, but the screw-set speculum should always be on hand.

As for the assistant, there are three things that he must learn to do: first, he must control the frontalis and hold the upper lid forward and downward; second, he must retract the lower lid with hook or thumb (his hand supported on the patient's face) and never evert or depress it; third, he must not desist until he is so directed, no matter what happens.

The best assistant is one of two groups: the intelligent nurse who knows only her orders—or the surgeon who has performed operations and so understands his orders. I believe that the first is the reasonable preference.

I can best sum up the difficulties by saying that any article advising and stressing an operative method should be followed by another entitled, "When Not to Use It."

The new intracapsular operation will win the operator's approval, because he can learn to do it without endangering the patient's eye; further, it necessitates no greater facility nor different experience from that which he possesses.

CLINICAL STUDIES IN SLIT-LAMP OPHTHALMOSCOPY *

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Somewhat more than a quarter of a century ago, Wolff constructed an ophthalmoscope in which the illumination was reduced to a narrow beam directed a little obliquely to the axis of observation. The aim which was to be attained by this construction was the oblique focal illumination of the retina and posterior portion of the vitreous, in the same manner as the slit-lamp corneal microscope gives oblique focal illumination of the anterior segment of the globe. Wolff's instrument, however, was of a cumbersome construction; the illuminating beam of light was not so sharply delimited as in the corneal microscope, for he used the unscreened filament of an electric bulb for his source of light instead of an illuminated slit; finally, the observing system gave no better definition of the ophthalmoscopic picture than that obtained in ordinary direct ophthalmoscopy. For these reasons, and perhaps also because physicians had not at that time become sufficiently aware of the possibilities and advantages of oblique focal illumination, the instrument was never widely used.

The problem was not attacked again until Koeppe introduced his modification of the slit-lamp microscope, adapting it to the examination of the fundus. As is well known, this was accomplished through the use of a corneal contact glass which has a refracting power equal and opposite to that of the eye. The retina, then, instead of appearing to lie at an infinite distance, could be seen in its actual position. The slit image is projected on the retina through the margin of the pupil, and the illuminated fundus is examined with a single-objective microscope. The main criticisms which have been raised against the method of Koeppe are that: 1. The contact glass is often difficult to apply to the patient's eye and often causes such pain and discomfort as to render an examination impossible. 2. The three independently moving parts of the optical system, namely, the illuminating arm, the patient's eye and the observing microscope, are difficult to manipulate together, and the optical construction of the observing system is such as

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* From the department of Ophthalmology of the Johns Hopkins Medical School.

* Read in part at the Meeting of the American Academy of Ophthalmology and Otolaryngology, St. Louis, Oct. 19, 1928.

to give a clear image only when the microscope and contact glass are accurately centered along the optical axis of the eye observed. A third objection of a more fundamental character may still be raised. The combination of a powerful concave lens in contact with the eye produces a high degree of spherical aberration in the fundal image, while the slight depth of focus intrinsic in a microscopic observing system exaggerates the effect of the normal chromatic aberration of the eye. Suffice it to say that this instrument has been available for almost a decade, and as yet no new clinical observations have been reported by its users.

When both the defects and the merits of these two methods are considered, it would seem possible to construct an apparatus which would possess the advantages of these instruments and which would be free from the disadvantages just mentioned. The ophthalmoscope which I have constructed in an attempt to meet this problem has been described in detail elsewhere.[1] Only those features which are germane to the present discussion, therefore, will be mentioned here. In the first place, the general plan of Wolff is preserved in that the illuminating and observing systems are rigidly connected in one instrument, which has been reduced in size so as to be no more cumbersome or difficult to handle than an ordinary self-luminous ophthalmoscope. The corneal contact glass, which is required only when a microscopic observing system is used, is discarded in this instrument. Instead of projecting the image of an electric bulb filament directly on the retina, the image of an illuminated slit is used, thus producing a sharply delimited beam of light which may be focused on the retina as accurately as the illuminating beam of the Koeppe slit-lamp. Finally, the illuminating and observing systems may be decentered in relation to one another so as to adapt the instrument to the size of the pupil of the eye observed, attaining in each case the maximum obliquity of the illuminating beam which the size of the pupil will permit.

By basing the observing system on that of an ordinary direct ophthalmoscope, or at most using a telescopic ocular, one can avoid adding to the optical imperfections of the normal eye and can even direct attention toward reducing these aberrations as far as possible. The aberrations in the eye, as in every other optical system, are of two kinds, chromatic and spherical, and each can be attacked independently in the effort to sharpen the ophthalmoscopic image. In the instrument which is being discussed, a crown-flint doublet is inserted in the observing

1. Friedenwald, J. S.: A New Ophthalmoscope: A Preliminary Note, Bull. Johns Hopkins Hosp. **40**:201 (April) 1927; A Critical Study of the Modern Ophthalmoscope: Contributions to Its Construction and Use, American Ophthalmological Society, Thesis, 1928.

system. This doublet is constructed so as to have a chromatic aberration equal and opposite to that of the normal eye. Furthermore, color filters can be introduced into the illuminating system so as to reduce the spectral range of the light used. The spherical aberration cannot be so simply combated. In some degree it can be reduced by reducing the aperture of the observing system, but there are limits to the beneficial effects that may be obtained in this way. When the aperture is made too small, the brightness of the image is much reduced and its definition is impaired due to interference phenomena. For direct observation with this instrument, a pupil aperture, 2 mm. in diameter, has been chosen as that calculated to give the best definition in the fundal picture. When the telescopic ocular is applied, a larger aperture may be used, as the spherical aberration of the telescope is overcorrected and partially counterbalances that of the eye. Two (I and III) of the three sets of observations to be recounted were attained through oblique focal illumination of the lesion, while the other (II) was the result of the increased definition in the ophthalmoscopic picture, which is achieved by this instrument.

I. CYSTIC DEGENERATION OF THE MACULA

On ophthalmoscopy with the ordinary type of instrument, the group of cases reported present the appearance of a hole in the macula, but with the slit-lamp ophthalmoscope the cystic nature of the defect is readily recognized, as is seen in figure 1. The cases which have hitherto been designated under the general rubric of hole in the macula fall into three groups, (1) those which follow injury, (2) those which follow inflammatory diseases of the eye and (3) those which occur spontaneously without antecedent ocular disease. It is to this third group that the cases described belong. That a true hole in the macula can occur has been amply demonstrated by anatomic studies.[2] There is, furthermore, histologic evidence that cystic degeneration of the macula can occur; it has been suggested that the cases of spontaneous hole in the macula may be the result of the rupture of a macular cyst.[3]

The histologic studies indicate clearly that the cysts develop as a result of a hemorrhagic or serous exudation. There seems to be no fundamental anatomic difference between those which occur as a complication of prolonged intra-ocular inflammation (iridocyclitis) and those which occur spontaneously in elderly people, in whom an arteriosclerotic disease of the macular vessels is probably responsible for the original serous or hemorrhagic exudation. Most of the cases of spon-

2. Leber: Diseases of the Retina, ed. 2, Graefe-Saemisch, vol. 7, p. 1654.

3. Archangilsky: Klin. Monatsbl. f. Augenh. **74**:266, 1925. Williamson: Am. J. Ophth. **5**:139, 1922.

taneous hole in the macula described in the literature have been bilateral, and almost all have occurred in elderly women.

REPORT OF CASES

CASE 1.—*History.*—Miss W., a white woman, aged 60, had pneumonia in 1927, and a rather severe diabetes developed. After the infection disappeared, the diabetes became mild and was readily controlled by diet. The patient complained of the presence of a black spot before her eyes for some weeks. The left eye "blurs" at times.

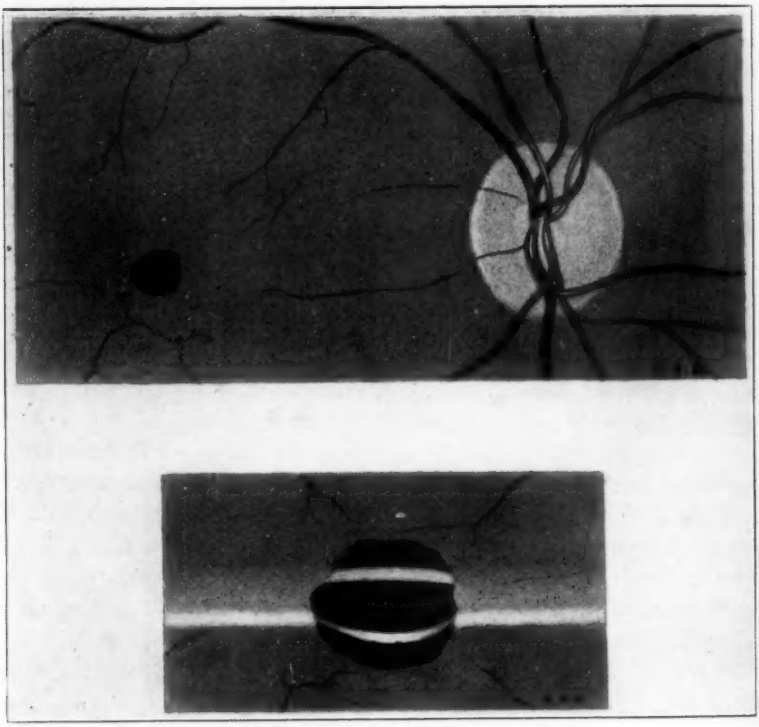

Fig. 1.—Senile cystic degeneration of the macula. Above, appearance with ordinary ophthalmoscope suggestive of a hole in the macula. Below, appearance with the slit-lamp ophthalmoscope, demonstrating the cystic character.

Examination.—In the right eye, the vision was 6/12. The media were clear. No signs of retinal arteriosclerosis were noted. In the right fovea there was a small, dark red, sharply circumscribed spot about one-third the diameter of the disk, which with the ordinary ophthalmoscope appeared to be a hole in the macula. Its appearance as seen with the slit-lamp ophthalmoscope is shown in figure 1. In the left eye, the vision was 6/9, 6/6 almost. The results of ophthalmoscopic examination were negative. A general examination was made by Dr. Eugene Leopold: The blood pressure was normal; there was a mild diabetes under satis-

factory control; a chronic gastric hyperacidity and a mild chronic arthritis were present.

Course.—There was no change in the vision or in the eyegrounds in three months.

CASE 2.—*History.*—Mrs. N., a white woman, aged 50, had noted failing vision for the last eight months, more rapidly so for the last four weeks.

Examination.—In the right eye, the vision was 6/60; the media were clear. The larger retinal arteries were of good caliber, but showed marked beading and slight increased visibility of their walls. There was marked arteriovenous compression. At the upper temporal margin of the disk a small bed of dilated capillaries and one flame-shaped hemorrhage were seen. The retina in the macular region had a glassy, watery appearance, and on indirect illumination, fine weblike irregularities were seen in its structure. There were many colloid excrescences of Bruchs membrane. In the fovea there was a dark red, horizontally oval, sharply outlined spot about two-thirds the size of the disk, which with the slit-lamp ophthalmoscope appeared definitely cystic. In the left eye, the vision was 6/24. There were a few spicules in the lens. The retinal blood vessels showed much the same condition as in the other eye. There were many petechia in the macular region, but a foveal lesion was not present. A physical examination was made by Dr. Frank R. Smith: The blood pressure was 205 systolic and 100 diastolic. The heart was not enlarged. The urine showed a trace of albumin but no casts. Results of the examination were otherwise negative.

Course.—The vision fluctuated irregularly for more than a year. At the last examination the cyst could no longer be clearly recognized, and beginning diskiform degeneration (Scheibenformige Entartung) was present in each macula.

CASE 3.—Mrs. P., a white woman, aged 58, had had blurred vision of the right eye for six months. She noticed a small, dark circle in the center of the field of vision when she read.

Examination.—In the right eye, the vision was 6/12; the media were clear. No retinal arteriosclerosis was noted. In the fovea there was a small cyst, which was identical in appearance with that in case 1. In the left eye, the vision was 6/6. The results of the ophthalmoscopic examination were negative.

Course.—Six months later, the patient returned and said that she noticed a similar dark ring before the left eye. Examination at this time showed that the vision in the right eye was 6/12. The foveal cyst had disappeared entirely, and only a slight irregularity remained in the choroidal pigmentation beneath the macula. In the left eye, the vision was 6/9. There was a typical foveal cyst similar to that previously seen in the right eye. The results of a general physical examination were completely negative. The urine was normal.

COMMENT

The cystic nature of the macular changes in the cases reported is so clearly demonstrable with the slit-lamp ophthalmoscope that additional proof need hardly be given. The disappearance of the cyst in the right eye in case 3, however, may be mentioned in support of the diagnosis, for it is inconceivable that a hole in the macula should disappear so completely. In case 3, neither ophthalmoscopic nor clinical evidence of

arteriosclerosis was found; however, the patient is 58 years old, and no other more likely explanation for the foveal lesion presents itself.

II. SEROUS TRANSUDATES NEAR THE OPTIC DISK

A problem of major importance both to the clinical ophthalmologist and to the ophthalmologic pathologist is the mutual reconciliation and reinterpretation of ophthalmoscopic and histologic pictures. In many respects this is not an easy task. The retina is a highly translucent tissue, and slight local changes in the index of refraction of its tissue fluids may reveal themselves to the ophthalmoscopist as gray or whitish patches, though microscopic sections of the same region may show no abnormality. On the other hand, lesions which are obvious to the histologist may escape ophthalmoscopic detection if the color and translucence of the lesion differ little from those of the surrounding retina. Among the latter group are serous extravasations in the retina which occur commonly in albuminuric retinitis and choked disk. There are, in general, two forms of such extravasations. Those which occur in the nerve fiber layer of the retina spread out flatwise in this layer, but do not, unless they are large, extend deeper into the retina. Like the flame-shaped hemorrhages which occur in the same region, their outlines are ill defined. On ophthalmoscopic examination, they appear, if at all, as faint grayish "cotton-wool" spots. The second form of serous extravasations embraces those which occur in the deeper layers of the retina. Here, as is well known, the accumulation of fluid usually takes place between the fibers of the outer fibrillar layer, pushing the fibers aside so as to form irregular or oval spaces.

In the macular region, these serous accumulations usually are found in the layer of Henle. They are often fairly large, almost always oval and tend to string out in a radial spokelike arrangement about the fovea. When they become infiltrated with hyaline or lipoid material, they are readily visible with the ophthalmoscope and constitute the so-called star-shaped figure at the macula. In the region about the optic disk, these serous accumulations are less often round or oval, and tend to fill an irregular network of interlacing channels. No doubt this difference is the result of slight local differences in the anatomy of the Müller supporting fibers of the retina. This network, which is a well recognized histologic structure, is of such size as to be well within the limits of ophthalmoscopic visibility; however, the difference in translucency of the serous accumulations and of the surrounding retina is so slight as to escape notice. With the increase of definition brought about by the suppression of the chromatic aberration of the ophthalmoscopic image, as attained in the new instrument, this network can be seen in most cases of albuminuric retinitis and of choked disk (fig. 2).

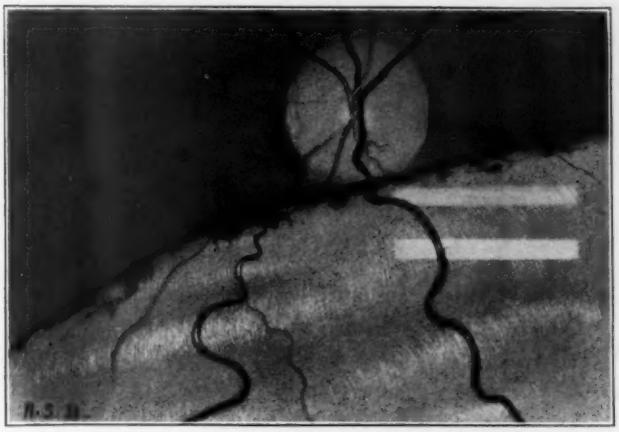

Fig. 2.—Detachment of the retina two years after onset. Note that the subretinal fluid is optically clear.

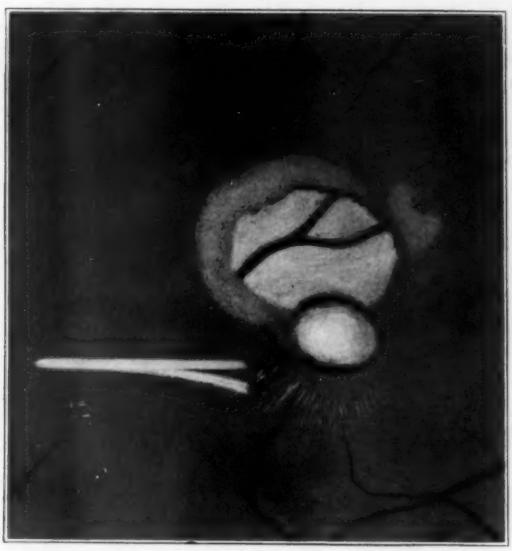

Fig. 3.—Old choroidal scar at the macula of a boy, aged 10. The round fibrous nodule at the margin of the scar caused localized tentlike detachment of the retina. The slit-lamp ophthalmoscope showed the extent of the detachment and also the clarity of the subretinal fluid.

III. SUBRETINAL EXUDATES AND DETACHMENT OF THE RETINA

The use of the narrow, obliquely focused ophthalmoscopic beam in the study of cases of detachment of the retina has rendered possible some observations on the character of the subretinal fluid. In cases of long-standing detachment, this fluid usually appears entirely clear. The beam cannot be seen from the place where it leaves the retina to that

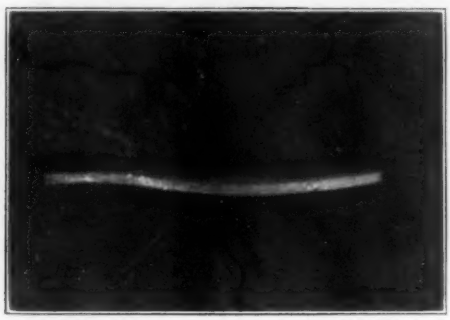

Fig. 4.—Flat detachment of the retina in the macula in albuminuric retinitis. Note the turbidity of the subretinal fluid. This picture is to be distinguished from retinal edema by the absence of pitting at the fovea.

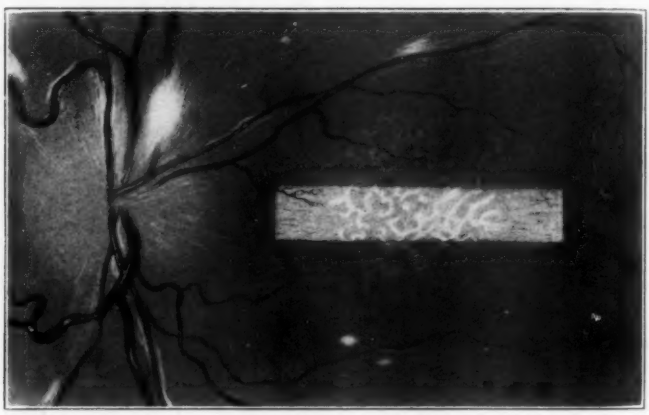

Fig. 5.—Serous exudate in the retina on the nasal side of the optic disk in a case of albuminuric retinitis.

where it strikes the choroidal lamella—the intervening space is optically as empty as the normal aqueous (figs. 3 and 4). In fresh detachments of the retina, and especially in the flat detachment so commonly seen in albuminuric retinitis, the subretinal fluid is relatively turbid, and the passage of the beam from the retina to the choroid is clearly visible (fig. 5).

RADIUM THERAPY IN DISEASES OF THE EYE AND ADNEXA*

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The three types of rays given off in the spontaneous disintegration of radium atoms are the alpha, the beta and the gamma. The alpha rays comprise 90 per cent, the beta 9 per cent and the gamma 1 per cent of the quantity of radiation. In quality or relative penetration, however, the gamma rays are one hundred times as penetrating as the beta, and the beta one hundred times as penetrating as the alpha rays. The alpha rays will not penetrate a thin sheet of writing paper; they are absorbed by 3 cc. of gaseous air, and are of little therapeutic value. The beta rays are screened off by 1 mm. of brass, silver or platinum, and are absorbed by 0.5 cc. of tissue.

In radium therapy, as in drug therapy, the effects depend on the dosage used and the mode of administration. Radium may be applied to the surface of a lesion, at a distance, or implanted within the tumor mass.

Radon, the radioactive gas of radium, can be sealed in tubes or in capillary gold or platinum implants and used instead of radium salts contained in needles and other applicators.

In vernal catarrh, an unscreened 5 mg. radium plaque is employed; in epitheliomas of the eyelids, gold filtered radon implants or small radium needles are applied interstitially, or surface applications are made; whereas in irradiation of the orbit, a radium pack of a few hundred milligrams is applied at a distance of from 3 to 6 cm.

In vernal catarrh, after cocainization, the eyelids are inverted and retracted. An application of a 5 mg. radium plaque is made for a period of ten minutes at intervals of from seven to fourteen days. Within two or three days after the initial treatment, the patient notes an improvement in the condition of the eyes. The pain is less, the scratchy feeling disappears, the secretions decrease and the photophobia is less marked. The cobblestone lesions appear to soften, become flatter and gradually disappear. A total dosage of from 300 to 600 mg. minutes is required in the treatment of these lesions. Some of them are stubborn, others disappear quickly. Surgical removal or electrodesiccation previous to irradiation would probably hasten the end-result.

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* Submitted for publication, Jan. 20, 1929.

* Read before the Section on Ophthalmology, the New York Academy of Medicine, Dec. 17, 1928.

The radium plaque methods permit the use of the beta rays as well as of the gamma rays; whereas in a plaque composed of radium needles, the beta rays are absorbed. A greater inflammatory reaction is likely to result from the use of a beta ray plaque. With mild doses frequently repeated, no ill effects on the eye have been noted. In thirty-four cases satisfactory results have been obtained, and in the majority of cases the granulations have disappeared. In the cases in which treatment has been given, the recurrent attacks the following spring have been milder, and each succeeding year fewer treatments have been given.

My personal experience in the treatment of chronic trachoma with radium has been too meager to quote results. Some benefits have been noted in a series of four cases.

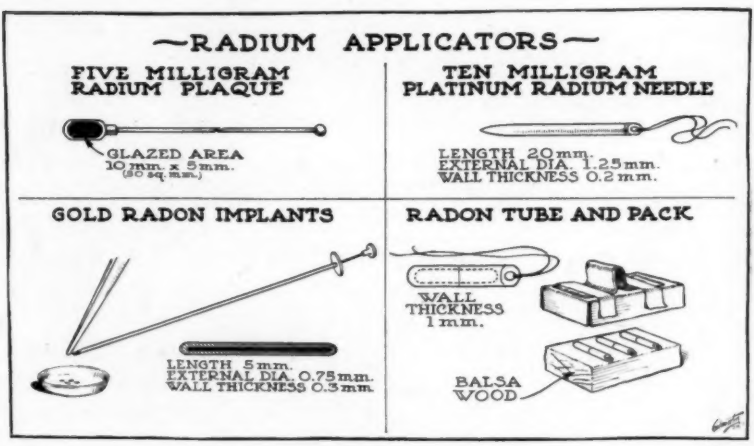
—RADIUM APPLICATORS—
FIVE MILLIGRAM RADIUM PLAQUE
GLAZED AREA 10 mm. x 5 mm. (50 sq. mm.)
TEN MILLIGRAM PLATINUM RADIUM NEEDLE
LENGTH 20 mm.
EXTERNAL DIA. 1.25 mm.
WALL THICKNESS 0.2 mm.
GOLD RADON IMPLANTS
LENGTH 5 mm.
EXTERNAL DIA. 0.75 mm.
WALL THICKNESS 0.3 mm.
RADON TUBE AND PACK
WALL THICKNESS 1 mm.
BALSA WOOD

Fig. 1.—Radium applicators.

EPIDERMOID CARCINOMA OF THE EYELIDS

Rodent ulcers of the eyelids are radiosensitive, and a uniform success is achieved by proper treatment. Fibrous tissue base and slender strands of tumor cells beneath apparently healthy tissue require maximum irradiation effects in the depths of the tumor rather than at the surface. I believe that in many cases treatment by means of x-rays and surface applications of radium has been unsuccesful simply because the base and actively growing areas of the tumor did not receive effective radiation. The technic of inserting small platinum radium needles or gold radon implants into the base of the lesions is sound. Furthermore, by means of the interstitial method, less radiation falls on the ocular conjunctiva. Each millicurie of radon gives off a total radiation of 133 millicurie hours, and will irradiate approximately 1 cc. of tumor tissue. In a few cases in which the primary lesions have penetrated into the

orbital cavity or extended from the lids to the eyeball, enucleation is advised previous to radium therapy. Adenocarcinoma and squamous cell carcinoma of the lids rarely occur.

CASE 1.—In January, 1928, Dr. N. Frank Irwin referred to me a young man, aged 20, with a rapidly growing ulcerated lesion in the middle of the lower lid. It had been present about six weeks and measured 2 by 1 cc. The Wassermann reaction of the blood was one plus; the Kahn test was negative. Antisyphilitic treatment did not improve the condition. A section showed a greatly proliferated stratified epithelium with marked papillary infiltration and penetration of the stroma. There were numerous mitotic cells and a few epithelial pearls. The diagnosis of squamous cell epithelioma was confirmed. The radium treatment consisted of the implantation of four 10 mg. platinum radium needles into the base of the growth for two hours. In addition radiation with gamma rays was applied to the surface of the growth and the surrounding tissues for nearly 300 milligram hours. Two weeks after the initial treatment, the lesion had been reduced two-thirds. In two months, the lesion appeared to be healed.

In four of a series of eighty-two cases, enucleation was necessary because of extention of the condition to the orbit or eyeball. One was a case of adenocarcinoma of the upper lid reported by Dr. Herbert W. Wootton in the ARCHIVES OF OPHTHALMOLOGY in 1927. In two other cases, the lesion invaded the orbit; in one, operation was performed, and in the other the condition was apparently under control by means of treatments with radium. In the rodent ulcers that are confined to the lids, radium is a specific treatment; less deformity occurs than when operation is done, and the function of the tear duct is preserved.

I shall report a case of plexiform neurofibroma of the upper lid in which operation was performed by Dr. Frank C. Keil, who kindly referred the patient to me for treatment with radium.

CASE 2.—F. C., aged 7 years, of Italian parentage, was admitted to the Manhattan Eye, Ear and Throat Hospital on Jan. 14, 1925.

When the child was 15 months of age, it was noticed that the left upper eyelid had become enlarged and drooped. The patient was operated on, but the condition was unimproved and the eyelid continued to enlarge. Three years later, he was again operated on, at the New York Eye and Ear Infirmary, without any permanent result. After that, the lid grew rapidly until it reached its present size.

Examination of this lesion revealed marked hypertrophy of the left upper eyelid, which hung from the orbit with complete loss of power. The skin was normal in color. The conjunctival aspect showed a thickened palpebral conjunctiva with a vertical scar, the remains of a previous operation.

On palpation, the lid had the consistency of soft rubber, with entire absence of tenderness toward the inner canthus at the margin of the lid; it seemed to be the remains of a tarsal cartilage.

The diagnosis of a neurofibroma was made. Two plastic operations were performed within four months. The tumor began to recur. Radium was used after a third plastic operation. Since that time, the condition has remained apparently cured. At the time of the last visit, during April, 1928, there had been no recurrence of the growth.

A specimen removed at operation and examined by Dr. Andrew A. Eggston, showed the tumor mass to be composed of greatly thickened epineurium of a rather loose fibrillar nature. Van Gieson's stain showed these fibers to be connective tissue. The central core of the nerves showed the actual nerve fibers which by Weigert's myelin sheath stain showed myelin sheaths present in many of the nerves. However, some of them showed no myelin sheathed nerves remaining. In these the fibrous tissue occupied practically the whole nerve area.

HEMANGIOMAS

Endothelial cells lining the capillaries that compose angiomas are radiosensitive. An obliterative fibrosis is produced after irradiation. In the large cavernous angiomas of the orbit, it is difficult to produce a fibrosis of the lesion, and surgical procedures are indicated. Postoperative radium may be employed if the growth has not been completely excised. Most angiomas appear at birth or soon afterward, although they may appear at any age. An interesting case in my series of twenty-two cases of angiomas is one in which an angioma appeared in the inner canthus of a girl aged 14 years. There had been two operations about six weeks apart, with prompt recurrence. After the third operation, the base of the lesion received two 10 mg. platinum radium needles for two hours and subsequent surface applications of radium. The angioma has not reappeared during a period of nearly three years.

I reported a case of vascular malignant tumor of the upper lid and retrotarsal fold before this section in February, 1926, as follows:

Case 3.—Mrs. C. B., aged 52, was referred, April 4, 1924, with a recurrent growth underneath the left upper lid at the retrotarsal fold. The tumor was first noticed about six month before, and was removed surgically after three months' duration. A growth recurring two weeks after operation was cauterized, and four weeks later was surgically removed again. Examination revealed a dark purplish, partially encapsulated tumor 2 by 2 by 1.5 cm., which bled freely on manipulation. The pathologic report was that the growth was a typical perithelioma, as shown by the sheets of polyhedral and rounded cells surrounding the arterioles.

One week after the initial radium treatment, the bleeding stopped and after four weeks, the growth was one-half the original size. Three months later, the growth was barely palpable, and at the present time there is no evidence of the growth nor of metastasis. A small area of fibrous connective tissue replaces the tumor, and the eye is apparently normal.

It is now more than five years since the onset of the growth. A small lymph node appeared in the pre-auricular region six months before the present writing and was considered a metastasis. Three thousand milligram hours was applied at a distance of 3 cm. and the node disappeared. The patient appears to be free of visible evidence of the sarcoma at this time.

Radium is of great value in the treatment for epibulbar carcinoma. These malignant lesions grow slowly as a rule and penetrate the globe

only in the late stages of the disease. The cornea and sclera offer considerable resistance to invasion. The usual round-cell infiltration which accompanies epidermoid carcinoma in other parts of the body is lacking in epibulbar lesions. Of six primary cases, only one showed intra-ocular penetration. Radium therapy was used in the other

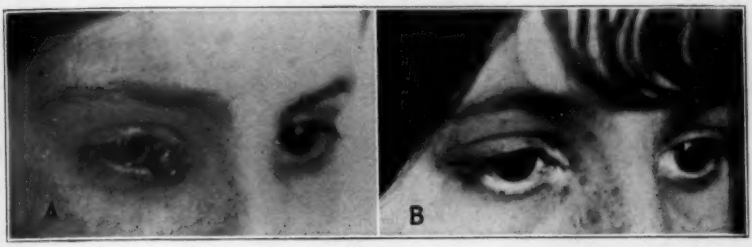

Fig. 2.—*A*, a recurrent hemangioma at the inner canthus of the eye; *B*, the healed lesion, three years after treatment with radium.

Fig. 3.—Hemangioma.

five, and one patient has remained well for five years; two, for four years; one, for two years, and one, for eight months. I treated one patient with melanoma of the eyeball; this patient was observed for three years, but no follow-up has been obtained. Radium has also been used as a postoperative procedure in treatment for pigmented moles of the cornea.

Papillomas of the lid respond to treatments with radium, resulting in little deformity and scant loss of eyelashes. Pigmented moles of the lids are resistant to treatment, and should be surgically removed or treated with electrodesiccation. Melanomas of the eyelids also require caustic doses of radiation for destruction and electrodesiccation should be used before radium is applied as a postoperative measure.

Fig. 4.—*A*, a recurrent perithelioma of the left retrotarsal region; *B*, the healed lesion, five years after treatment with radium.

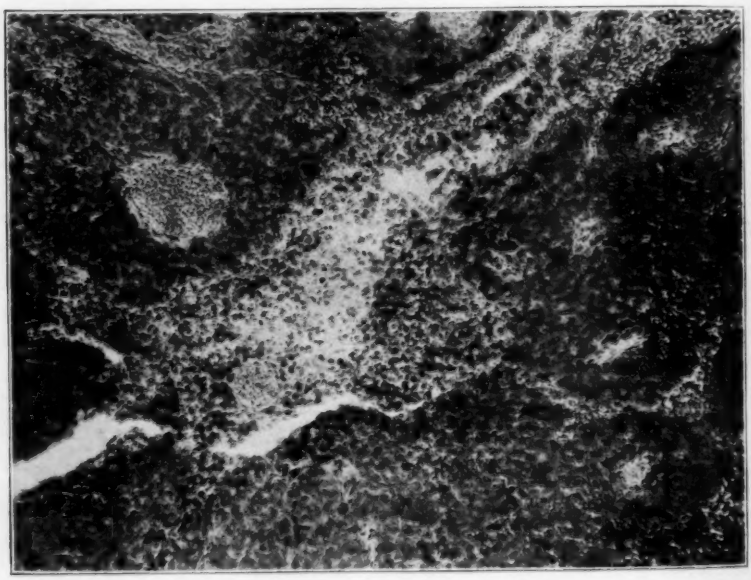

Fig. 5.—Perithelioma (case 3).

Keloids of the lids respond to radium therapy. The earlier the treatment is applied to the hypertrophic scars, the quicker are results obtained, as the young fibroblasts with a collagen matrix are radiosensitive.

Dense firm scars are radioresistant. Excision followed by radium to prevent recurrence is suggested. There is a definite indication for

the use of radium in conjunction with plastic operations on the lids and face.

I have applied radium to the orbit for the following conditions: melanoma (ten cases), glioma (seven cases), carcinoma (seven cases) and sarcoma (six cases).

In four cases, the melanoma had not grossly penetrated through the eyeball; in three of these the patients have been well for a period of from six months to two years; the fourth patient died of metastasis to the liver five years after operation. Of the six patients in whom the melanoma had perforated the eyeball, one has been well for five years, one for one year and one for six months; the other three died.

Of seven patients with glioma, only one has been free from recurrence for four years. Three patients had invasion to the opposite eye when first seen.

In seven cases of carcinoma of the orbit, the growth in one was an extension from the ethmoid area; in two, from the maxillary antrum and in five, from the lids. Three of this group of patients have been well for more than three years.

Of the six patients with sarcoma of the orbit, one with an angiosarcoma is well ten years after operation and radium treatment; one with lymphosarcoma and one with a perithelioma are well after five years.

120 East 75th Street.

KRUCKENBERG'S SPINDLE, A FUSIFORM PIGMENTATION OF THE CORNEA

REPORT OF A CASE *

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The patient presenting the condition herein described came to the service of Dr. Grout at the Knapp Memorial Eye Hospital for relief of symptoms of migraine. In the course of a routine examination, it was discovered that he had a curious pigmentary deposit on each cornea. By indirect illumination these deposits were seen to be fusiform, apparently lying on or in the posterior corneal strata and inclined slightly, with the upper ends temporally from the midline about 15 degrees. Their length was about two-thirds that of the corneal diameter and the centers about 1.5 mm. below the center of the cornea.

Examination with the slit-lamp disclosed the mass of pigment to be a conglomeration of individual dots of chocolate brown pigment, the dots being larger and heavier in the area of the spindle, with finer and less numerous points for about from 1 to 2 mm. around the main mass. The pigment dots were circular and flat and lay just behind Descemet's membrane on the posterior endothelium. The iris was blue gray, and showed no signs of previous inflammation. However, over its surface were strewn dustlike clumps of fine brown pigment, for the most part lodging in the crevices of the muscle bundles of the iris. There were remnants of the fetal pupillary membrane in the right eye but none in the left. The lens and interior of the eye showed no abnormalities.

The patient gave his age as 32. The personal and family history were negative. He was moderately myopic, and his corrected vision just failed to reach 20/20. The central and peripheral fields were normal, but the patient said that he had to look to the side of small objects in order to see clearly, obviously in order to avoid interference from the centrally placed opacities. His only child, aged 3 years, did not show a similar condition.

There has been comparatively little discussion since the first description of this condition by Kruckenberg in 1889. In all, some thirty cases have been reported. The characteristics of this condition may be summed up as follows: 1. It occurs in almost constant association with myopia. 2. It occurs in adults and never in children, 22 years being the age of the youngest patient. The majority of subjects were between the ages of 40 and 65. 3. It is nearly always bilateral. 4. The center of the spindle lies below the center of the cornea. 5. The poles of the spindle reach neither the upper nor the lower limbus. 6. It is completely independent of persistent pupillary membranes or other congenital anomalies.

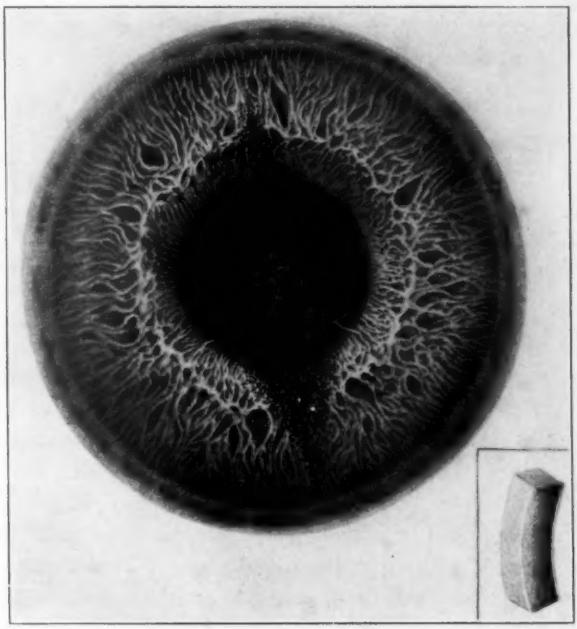
* Submitted for publication, Jan. 21, 1929.

LOCATION

Before the advent of the slit-lamp, the earliest observers considered the pigment as being interstitially placed, but the later descriptions all agree that it lies on or in the endothelial surface.

ETIOLOGY

Kruckenberg, Stock[1] and Vogt believed the condition to be prenatal in origin. They considered it to be derived from a persistent pupillary membrane attached through fetal disease to the posterior cor-



A case of Kruckenberg's spindle.

neal surface. For this view there is only one confirmatory observation: the fact that the color of the spindle is the same as the color of the iris pigment. A case has been cited in which there were gray irides with grayish spindles. Obviously, this cannot carry weight since the actual pigment of the iris is always brown, whether the iris is blue or brown. The patient whose case is herein reported had a gray iris with a dark brown spindle. Against this congenital view, there are several stronger arguments. The most important fact is that the condition has never been seen in infants or children. It is not associated with other tags of

1. Stock: Klin. Monatsbl. f. Augenh. **2**:770, 1901.

persistent pupillary membrane. Furthermore, Koby [2] reported two cases in which the condition developed in adult patients under his observation.

The first patient was a young woman with iritis. After recovery and four months after the onset, a spindle was observed to be forming in one eye but not in the other. The second eye did have a central circular patch of gray keratitic deposits. At the first examination the other patient had a great number of pigment dots sprinkled over the cornea. One and a half years later, he presented a Kruckenberg's spindle in only one eye. There were no signs of inflammation or degeneration of the iris. Thus, two cases are recorded by an unquestionably competent observer, both unilateral; in one the condition occurred after a definite inflammation, in the other it appeared more slowly, without any inflammatory signs.

HEREDITY AND SEX

There are three sets of cases reported in which the condition existed in mother and daughter. Among the patients whose cases are reported, females preponderate by far.

PATHOLOGY AND PATHOGENESIS

Only one eye has been observed microscopically. In 1923, Hanssen found a disintegration of pigment in the iris with cells in the angle of the anterior chamber, in the zonular fibers and in the valleys of the ciliary processes, but he found no signs of actual inflammation.

Koby explained the peculiar formation as being due to convection currents in the anterior chamber following the line of Ehrlich-Turk, the granules scratching and roughening the delicate posterior endothelial cells and thereby facilitating the deposition. The usual triangular arrangement is not formed, because the pigment is finer than the ordinary keratitic deposits and does not sink as fast. The center of the spindle lies below the center of the cornea owing to the action of gravity. Pigment disintegration is facilitated by myopia, senility and chronic inflammation. Koby inferred that if the formation of the spindle is accompanied by an inflammatory process, the formation takes a shorter time; if it occurs without inflammation, it takes a longer time. Kraemer's case, in 1906, in which he found horizontal spindles, must be mentioned. This does not fit in with Koby's theory, but Kraemer did not have the advantage of viewing the eye with a slit-lamp, and there may have been an altogether different microscopic appearance.

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2. Koby, F. E.: Pathogénie de la pigmentation fusiforme de la face postérieure de la cornée, Rev. gén. d'ophth. **51**:52 (Feb.) 1927.

COMMENT

The special characteristics of the case here reported are: (1) the age of the patient, the case of only one younger patient having been described; (2) the oblique direction of the spindles, which is a departure from the usual formation; (3) the persistence of a pupillary membrane, which is an exceptional observation, and (4) the difference in the color of the iris, which was blue, and that of the pigment spindle, which was brown.

In conclusion, one must bear in mind that Koby's contribution lends a pathologic import to Kruckenberg's spindle, so that it must no longer be regarded and passed over as a developmental curiosity, but rather as an accompaniment to a diseased state.

THE RETROLENTAL SPACE *

L. W. MORSMAN, M.D., M.S. OPH.
HIBBING, MINN.

Previous to 1914, there appears to have been no conception of the fact that there might be a retrolental space containing aqueous, and that the lens was suspended in and totally surrounded by aqueous.

ANATOMY

The relationship of the lens and the vitreous as commonly accepted before the use of the slit-lamp microscope was described by Fuchs [1] thus: "The posterior surface of the lens is embedded in the fossa patellaris of the vitreous." In his description of the vitreous, he said: "On its anterior aspect it has a depression (the fossa patellaris), in which rests the posterior surface of the lens." Further bearing out the general idea of close contact between the lens and the vitreous, Butler [2] quoted Priestley Smith's conversation as follows: ". . . he had dissected scores of human eyes with the express object of examining the vitreous, and in all cases the vitreous was adherent to the back of the lens, and detached only with difficulty." It was further believed that there was a definite membrane, the hyaloid membrane, dividing the vitreous from all parts forward. This was first thought to be impervious, but clinical observations showed that there must be some permeability. In support of this, de Schweinitz [3] quoted Priestly Smith as saying: ". . . it is doubtful if there is any continuous stream from the vitreous into the aqueous chamber, but the anterior hyaloid membrane and suspensory ligament are easily permeated by it. . ."

On the other hand, authors were in agreement that the margin of the lens came in contact with the aqueous through the interspaces (spatia zonularis) of the fibers of the zonula ciliaris, Spaltholz [4] having stated that the spaces were large and communicated freely with each other

* Submitted for publication, Feb. 13, 1929.

* Read by invitation before the Sioux Valley Eye and Ear Academy, Sioux City, Iowa, Jan. 22, 1929.

1. Fuchs, E.: Text-Book of Ophthalmology, Philadelphia, J. B. Lippincott Company, 1919, p. 22.

2. Butler, T. Harrison: An Illustrated Guide to the Slit-Lamp, London, Oxford University Press, 1927, p. 107.

3. De Schweinitz, G. E.: Diseases of the Eye, Philadelphia, W .B. Saunders Company, 1916, p. 379.

4. Spaltholz, Werner: Hand-Atlas of Human Anatomy, Philadelphia, J. B. Lippincott Company, 1923, vol. 3, p. 807.

and with the posterior chamber in front and the surface of the vitreous behind. The absence of a zonular lamella limiting the aqueous to the front of the lens had already been disproved by a number of histologists, notably Salzmann and Hess.

THE RETROLENTAL SPACE

Gullstrand,[5] in 1911, was the first to observe the anterior surface of the vitreous with the slit-lamp microscope. In 1914, Erggelet[6] reported his observations of an empty space just back of the lens. In a publication in 1917, Vogt[7] confirmed Erggelet's observations. Koby,[8] Vogt,[9] Butler[2] and Meesmann[10] all gave details of the retrolental space in their texts on biomicroscopy. I have recently had the opportunity of studying the aqueous space in a boy aged 7 years, with congenital aniridia. This case was reported[11] in 1922, when the patient was 14 months of age. As this boy had a total absence of the irides and otherwise nearly normal eyes, he made a good subject for study. Figure 1 illustrates the extent of the aqueous in this patient's eyes. The picture shows a definite postlental space which extends back over the ciliary body. Figure 2 shows the appearance of the fibers of the zonule under a magnification of $\times 61$.

Biomicroscopy has given ophthalmologists a new conception of the structure of the human eye in regard to the relationship between the lens, ciliary body and vitreous. Figure 3 illustrates this relationship in cross-section. The drawing is made with a magnification of $\times 14$ after measurements of von Helmholtz. The postlental space is drawn in under an estimated magnification of the same amount after study of case 3916 illustrated also in figures 1 and 2.

TECHNIC OF EXAMINATION

Examination of the vitreous with the slit-lamp microscope is best conducted in an absolutely dark room. The examiner should have at

5. Gullstrand, Allvar: Demonstration der Nernstspaltlampe, O. G. Heidelberg, 1911, p. 374.

6. Erggelet, H.: Klinische Befunde bei fokaler Beleuchtung mit der Gullstrandschen Nernstspaltlampe, Klin. Monatsbl. f. Augenh., 1914, p. 449.

7. Vogt, Alfred: Ein embryonaler Kern der menschlichen Linse, Cor.-Bl. f. schweiz. Aerzte, 1917, no. 40; Der embryonal Kern der menschlichen Linse und seine Beziehungen zum Alterskern, Klin. Monatsbl. f. Augenh. **59**:452, 1917.

8. Koby, E. F.: Slit-Lamp Microscopy of the Living Eye, Philadelphia, P. Blakiston's Son & Company, 1925, p. 185.

9. Vogt, Alfred: Atlas der Spaltlampenmikroskopie des lebenden Auges, Berlin, Julius Springer, 1921, p. 128.

10. Meesmann, A.: Die Mikroskopie des lebenden Auges-Spaltlampen-Atlas, Berlin, Urban & Schwarzenberg, 1927, p. 124.

11. Morsman, L. W.: Total Coloboma of the Iris, Am. J. Ophth. **5**:647, 1922.

least five minutes in which to adapt himself to the darkness. The pupil should be dilated, the head comfortably fixed and the patient should be instructed to keep the eye looking directly forward at a real or imaginary object. The angle of incidence of the slit-lamp beam should be 30 degrees or less. The slit should be of medium width in the beginning and the microscope nearly directly in front of the patient's eye. Examination should be started with a magnification of × 23 (Ocular 2, Objective A_2 Zeiss) and increased as indicated to × 35 (Ocular 2, Objective A_3), × 40 (Ocular 4, Objective A_2) and × 61 (Ocular 4, Objective A_3).

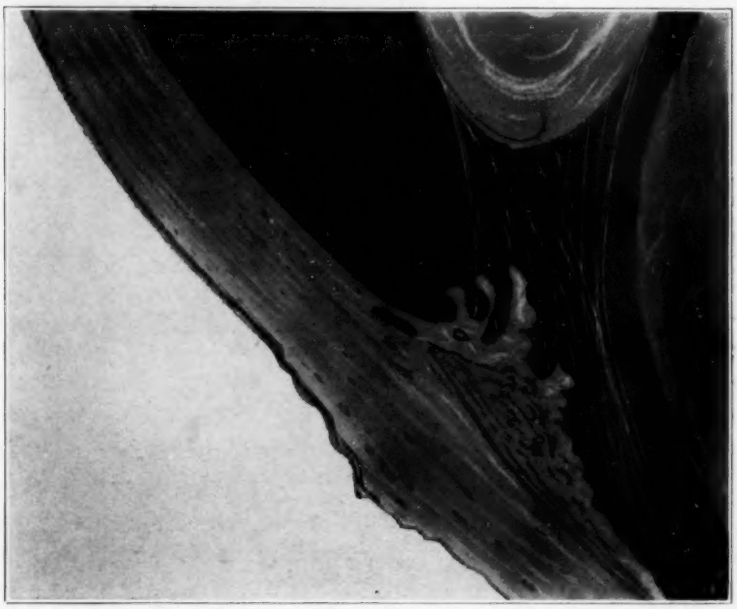

Fig. 1 (case 3916).—Schema illustrating the extent of the aqueous space in a boy, aged 7 years, with total congenital coloboma of the iris. The postlental space passes back over the ciliary body. The root of the iris has the appearance of being the first ciliary process. This study was made under a magnification of × 23 and with dark adaptation. All the drawings and illustrations were made by the author.

The posterior band of the lens is used as a landmark and is always brought sharply into focus at the beginning of the examination. Posterior lens deposits may now be studied. A little deeper movement of the microscope will allow study of any abnormalities of the normally optically inactive retrolental space. While focusing the microscope slightly further back, along the light beam, the observer will note the first impact of the framework of the vitreous.

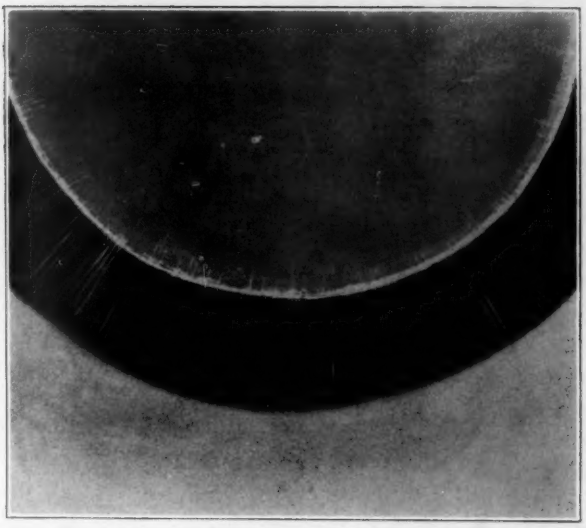

Fig. 2 (case 3916).—Total coloboma of the iris. Appearance of fibers of the zonule. Bands of the suspensory ligament appear in bundles or groups with interspaces through which interchange of aqueous may take place between the anterior and posterior chambers and the retrolental space. Ocular, 4; objective, A₂; magnification; × 61.

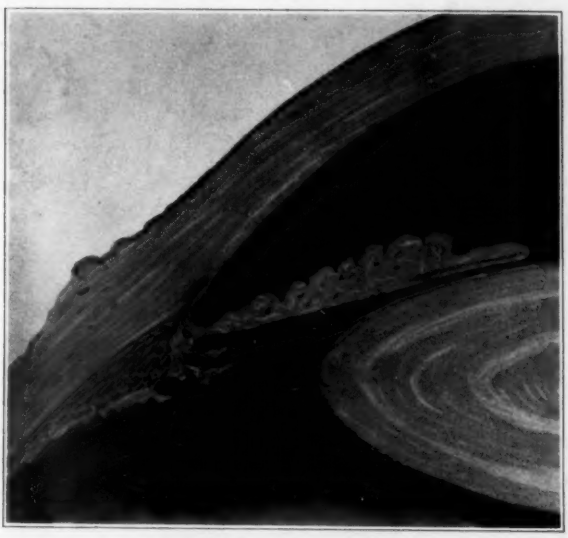

Fig. 3.—Cross-section of anterior segment of the human eye, illustrating newer conception of aqueous space brought out by biomicroscopic studies, the aqueous being in intimate contact with the posterior surface of the lens, vitreous and ciliary body and passing through the spatia zonularia into the posterior and anterior chambers; × 14 after proportions of von Helmholtz.

THE NORMAL POSTLENTAL SPACE

The normal content of the retrolental space is aqueous. In the average case, the space appears optically inactive. Graves [12] spoke of the aqueous "flare" and the "outstanding beam," indicating that the examiner is aware of some light reflex from the aqueous itself. While this is true with successful adaptation to darkness and high power magnification, ordinarily the space is spoken of and is found to be optically inactive.

The depth of the space back of the lens varies in each case, and the apparent depth varies with the illumination. The feebler the illumination, the deeper the space appears. Figure 4 illustrates what might be considered a normal space. This is approximately 1 mm. deep, judged by a comparison with the depth of the lens. The space may vary up to several times that depth, as is illustrated in figures 8 and 9. The latter, of course, shows a pathologic condition.

Normal structures found in the retrolental space are remains of the posterior capsulopupillary membrane and hyaloid artery. In most cases, a whitish, twisted remnant of the hyaloid can be found from 1 to 2 mm. to the nasal side of the posterior pole of the lens. These remnants may hang down through the lower part of the space or project back through the vitreous.

In some patients examined, one may find fine fibers connecting the posterior lens capsule with the anterior surface of the vitreous (figs. 4 and 5). They can be made out only when one uses high magnification ($\times 61$) and has good adaptation to darkness. They can be best observed when a slight lateral movement of the light beam is used. These fibers are seen frequently enough to be considered nonpathologic. One cannot help but wonder if it is not this type of case in which vitreous is lost when operation for cataract is performed by the intracapsular method.

As the examiner focuses the microscope further back, he brings into focus the anterior surface of the vitreous. While there is an impact line of light reflex, a reflecting surface that in any way would suggest a hyaloid membrane is never found. Rather, one has the impression of a fine fibrous framework without a sharp boundary having been added to the aqueous. A detailed discussion of the vitreous may be found in the texts of Koeppe, Vogt, Butler, Koby and Meesmann and in a special monograph of Bedell's.[13]

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12. Graves, B.: The Outstanding Beam of the Aqueous Fluid, Am. J. Ophth. **8**:8, 1925.

13. Bedell, A. J.: A Study of the Vitreous with the Slit-Lamp, Tr. Ophth. Soc. (England) **45**:646, 1925.

PATHOLOGY

The pathologic condition of the retrolental space is essentially that of the aqueous elsewhere. There is, however, a great advantage in examining the aqueous posteriorly, as it is here that inflammatory signs first appear. Also, it is easier to detect cells in the retrolental space because they are more numerous. These facts may be best brought out by citation of an actual case.

CASE 1.—Miss M. H., aged 20, reported at the clinic during November, 1928, that she had at times noticed slight blurring in the left eye. The history revealed nothing else of importance except that refraction had been done two years before and the patient given a + 0.50 diopter cylinder axis 90 degrees for each eye for relief of slight headaches after study. Complete examination of the eye (including examination of the ear, nose and throat) gave negative results except 20/30 vision in the left eye. Examination of the retrolental spaces with dark adaptation and a magnification of + 61 is shown in figures 4 and 5. From the condition found in the left eye, a focal infection was believed to be the cause of lowered vision. A complete physical examination was ordered, and a diagnosis of chronic appendicitis made. Focal infection of the appendix was confirmed at operation. Six weeks later, vision was normal and the retrolental space had cleared, but cell deposits remained on the fiber intersections of the vitreous.

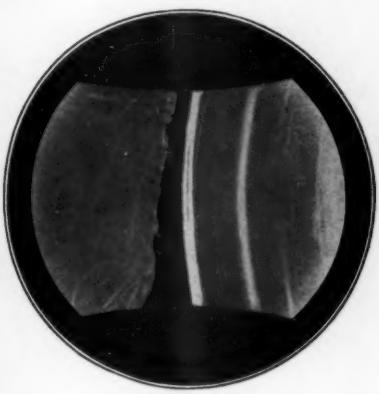

Figure 4

Figure 5

Fig. 4 (case 1).—A normal retrolental space and adjacent structures. This case shows fine fiber connection between the anterior surface of the vitreous and the posterior lens capsule. Ocular, 4; objective, A_3; × 41.

Fig. 5 (case 1).—First stage of cyclitis from focal infection, showing the retrolental space and the adjacent structures in the left eye. Cell groups and inflammatory products are found in the retrolental space and vitreous. Compare with the same patient's normal right eye shown in figure 4. Ocular, 4; objective, A_3; × 61.

These deposits will be permanent and must be differentiated from new deposits when examination is first made in any new case. Such

differentiation can be made by observing that deposits are found on fibers and intersections only and none in the interspaces of the vitreous or especially in the retrolental space. Chronic cases are likely to show deposits of pigment in the vitreous as well. The study of this case suggests the desirability of examining the second eye in patients suspected of having sympathetic ophthalmitis.

CASE 2.—Figure 6 illustrates a case of recurrent iritis in A. P., a man, aged 30, who has been under observation since June, 1925. During that time he has had two mild attacks with ciliary injection and photophobia. Vision in the left eye on examination was 20/200, secondary to injury of the cornea during childhood. The right eye was normal and uninvolved. Focal infection was found in the tonsils, which were removed in 1925 after the first observation.

In 1927, a recurrence of the irritation of the right eye subsided after the removal of two infected teeth. This patient has just returned to the clinic with

Fig. 6 (case 2).—Retrolental space and adjacent structures in a case of recurrent iritis. The vitreous and the retrolental space show cell deposits. The vitreous also contains pigment. Ocular, 4; objective, A_3; × 61.

recurrence of symptoms and is now under treatment and examination for a further source of infection. He was selected to illustrate the biomicroscopic examination of the retrolental space in a case of recurrent iritis.

The essential difference between this case and case 1 is that here pigment and more clumping of débris on the fibers of the vitreous are found. The latter case, too, showed external signs, such as ciliary injection, sluggish iris and exudate from the iris.

In contrast to these types, I wish to call attention to a case of gray cataract reported [14] in November, 1928. Figure 7 illustrates the cloudy condition of the anterior vitreous that takes place after years of recurrent or low grade cyclitis, due to continued deposit of inflammatory

14. Morsman, L. W.: Biomicroscopy of Lenticular Opacities, supplement, Am. J. Opthth. **11**:17 (Nov.) 1928.

exudate. It also shows that during quiescent stages in cases of low grade inflammation the retrolental space, being filled with aqueous, is able to clear itself.

An unusual type of retrolental space is shown in figures 8 and 9.

CASE 3.—A man, J. D., aged 41, had recurrent detachment of the retina in the left eye. The right eye was normal, and figure 8 is shown for comparison. This man was struck over the left eye on Oct. 10, 1928. Vision was limited to ability to see hand movements; the globe was injected; hemorrhage was present in the anterior chamber and there was slight dislocation of the lens backward and a slightly tremulous iris. The patient remained in the hospital for two weeks and was then dismissed. The eye was normal, except for dislocation of the lens and

Fig. 7 (case 43-4-46).—Appearance of the posterior half of the optical section of the lens, retrolental space and anterior vitreous in a case of gray cataract. *A*, iris; *B*, posterior cortex; *C*, the single opacity of the posterior cortex; *D*, the posterior capsule; *E*, the area between the lens and the vitreous-postlental space; *F*, anterior limiting surface of the vitreous; *G*, corpuscular deposits on fibers of vitreous found in cases of present or past cyclitis. Ocular, 2; objective, A_2; $\times$ 35.

lowered vision to 20/200. The employer's record showed vision 20/20 before the accident. At the time of dismissal vision was brought from 20/200 to 20/20 with -2.25 diopters spherical lens $\frown -1.75$ cylinder axis 120 degrees.

On Oct. 29, 1928, the patient returned to the office on account of blurred vision. Examination showed complete detachment of the retina throughout the entire upper visual field from 11 to 4 o'clock. The patient was again admitted to the hospital and operated on, Oct. 30, 1928, for detachment of the retina. Cautery punctures through the bared sclera above were made. The detachment immediately became reduced, and the retina has remained attached to date. On November 16, a second detachment of the retina took place below from 9 to 6 o'clock. Operation was

performed for this the same day. Two weeks later detachment took place from 6 to 9 o'clock, and operation was immediately performed. In the last two operations, reattachment was only partially successful. Within a few days the retina began to loosen throughout the lower visual field and continued to become detached until on December 7 the entire field below, beginning at 11 o'clock and continuing contraclockwise until 3 o'clock, was completely involved. The eye was then so irritable that further operative intervention was decided against until all reaction had subsided.

On Jan. 5, 1929, the two drawings shown in figures 8 and 9 were made. The eye was now quiet, and the turbidity of the media had disappeared. The examination of the retrolental space of the left eye on this date showed that the aqueous had cleared itself. The space was even larger than the normal, but unusually deep space, in the right eye. The vitreous was drawn up in folds, and the folds waved freely with the slightest oscillation of the eyeball. The lower fold noted in the drawing gave one the impression of the movements of seaweed floating up and down in the active current of the water secondary to wave action. In the vitreous

Figure 8

Figure 9

Fig. 8 (case 3).—Normal but increased retrolental space drawn for comparison with pathologic left eye shown in figure 9. Ocular, 4; objective, A_2; × 40.

Fig. 9 (case 3).—The appearance of the retrolental space and anterior vitreous in a case of recurrent detachment of the retina. Compare with patient's right eye in figure 8. Note excessive space, waves of vitreous and deposits of débris and pigment throughout the vitreous. The retrolental space is now cleared. Ocular, 4; objective, A_2; × 40.

were numerous deposits and débris and larger areas of pigment. These are illustrated by large white spots in the drawing, as it was not possible to indicate color in this type of illustration.

It would seem that with such a large ballooning forward of the retina one would expect to find the anterior surface of the vitreous closer to the lens than such a distance back. One also would wonder if there might be any association between large retrolental space and their possible extension back over the retina and tendency to detachment of the retina.

SUMMARY

From the study of the foregoing and similar cases, the ophthalmic surgeon can readily appreciate the practical use of the slit-lamp microscope in his daily office practice. It is extremely important to detect the earliest signs of inflammation, especially uveitis. On account of the structure and function of the retrolental space, it can be readily seen that the first sign of inflammation—cells in the aqueous—can first be detected here and the care of the patient thereby governed. A careful daily biomicroscopic examination of both eyes of any patient suspected of developing sympathetic ophthalmitis should thus be made. If there are no cells in the retrolental space or vitreous of an injured eye that is under suspicion, that eye most likely is not dangerous. If the retrolental space and vitreous acquire cells in addition to ordinary clinical signs of inflammation, then the eye is in a highly dangerous condition. If during the daily examination cells are found in the same location in both eyes with or without clinical signs in the second eye, that eye is in a sympathetic condition and active treatment must be undertaken.

CONCLUSIONS

1. Biomicroscopic study shows the crystalline lens to be totally surrounded by aqueous.

2. The retrolental space extends back over the ciliary body.

3. There appears to be no limiting membranous surface to the vitreous.

4. The first sign of inflammation may be found in the retrolental space.

5. Inflammatory products may pass readily from the aqueous into the vitreous.

6. After removal of a focus, inflammatory products tend to disappear from the retrolental space but tend to remain in the vitreous.

7. A careful examination of the retrolental space is most important in every case of suspected uveitis, especially so in sympathetic ophthalmitis.

METASTATIC CARCINOMA OF THE CILIARY BODY

REPORT OF A CASE *

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NEW YORK

A woman, aged 68, was seen on March 14, 1927, because two weeks before a change had been observed in the right eye, and a tumor of the ciliary body had been diagnosed by Dr. J. J. Burke of Washington. Eight years previously, her left breast had been removed; since then her health had been good.

On examination, the vision of the right eye was 20/40, and that of the left 20/20. On the temporal side of the right eye there was a growth pushing the iris away from its peripheric attachment. The growth was whitish gray with many blood vessels, and was covered with a curious flaky, white material which in places was massed in the form of balls. The growth measured about 10 mm. vertically and 3.5 mm. laterally. The eyeground was normal.

Though the patient's history suggested that the condition was a metastatic growth, the localization in the iris and ciliary body was so unusual and the patient's general health was so good that enucleation was advised and performed on March 15, 1917; healing was uneventful.

The left breast had been removed eight years before by Dr. E. G. Ramsdell of New York. This operation was followed by a course of deep roentgen therapy.

Microscopic examination of a section of tissue from the tumor of the breast revealed the presence of large numbers of epithelial-like cells growing wildly in strand, mass and gland arrangement. Carcinoma cells were seen in several small foci in the fatty structures surrounding the main tumor mass (fig. 1). Microscopically, the tumor was adenocarcinoma of the breast of a very malignant type.

On April 1, 1927, a roentgenogram of the thorax was taken which showed a thickening in the lower half of the left pleural cavity which represented an exudate presumably due to a pleural metastasis. There was no sign of mediastinal involvement (J. H. Steiner, Roosevelt Hospital).

The question came up as to whether further roentgen treatment should be given, but this was not considered necessary by Dr. James Ewing.

The microscopic examination of the eye showed a growth situated between the ciliary body and the ora serrata and the sclera (fig. 2). This mass seemed to be fairly well defined and had invaded the root of the iris and presented in the anterior chamber. The flaky, white, ball-like masses in the anterior chamber were collections of tumor cells. The growth was composed of epithelial cells resembling the structure of the original tumor of the breast. The cells were loosely grouped together at the root of the iris, while posterior to the ciliary body their arrangement was more striated. In the ciliary body they formed isolated alveoli (fig. 3). The eye otherwise was normal.

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* Submitted for publication, Feb. 5, 1929.

* Read before the New York Academy of Medicine, Section of Ophthalmology, Jan. 21, 1929.

The patient remained in good health in the fall of 1927; then she began to fail rapidly; the mediastinum and whole left side of the chest was solid with metastases, and she had a spontaneous fracture of the femur. On July 3, she was in a state of coma, and death followed on July 24. In other words, death occurred sixteen months after the occurrence of the metastasis of the eye.

Fig. 1.—Section of tumor of the breast.

The case presents a number of interesting features. Ginsberg [1] said that up to date seventy cases of metastatic carcinoma in the eye have been reported, and in one fourth of these the condition was

1. Ginsberg: Das Auge, in Henke and Lubarsch: Handbuch der speziellen pathologischen Anatomie und Histologie, 1928, vol. 11, p. 563.

bilateral. The primary growth is usually in the breast; next in frequency are the stomach, lungs, liver, mediastinum, thyroid, suprarenals and prostate. The uvea is a favored place for a metastasis from a carcinoma of the breast. The process is transmitted by the blood vessels along the ciliary arteries. The left eye is more frequently involved than the right. The metastasis is by way of the short posterior ciliary arteries so that, as is well known, the condition usually is represented by a flat, mottled tumor of the choroid at the posterior pole of the eye. Exceptionally, the metastasis travels by the anterior ciliary vessels, and

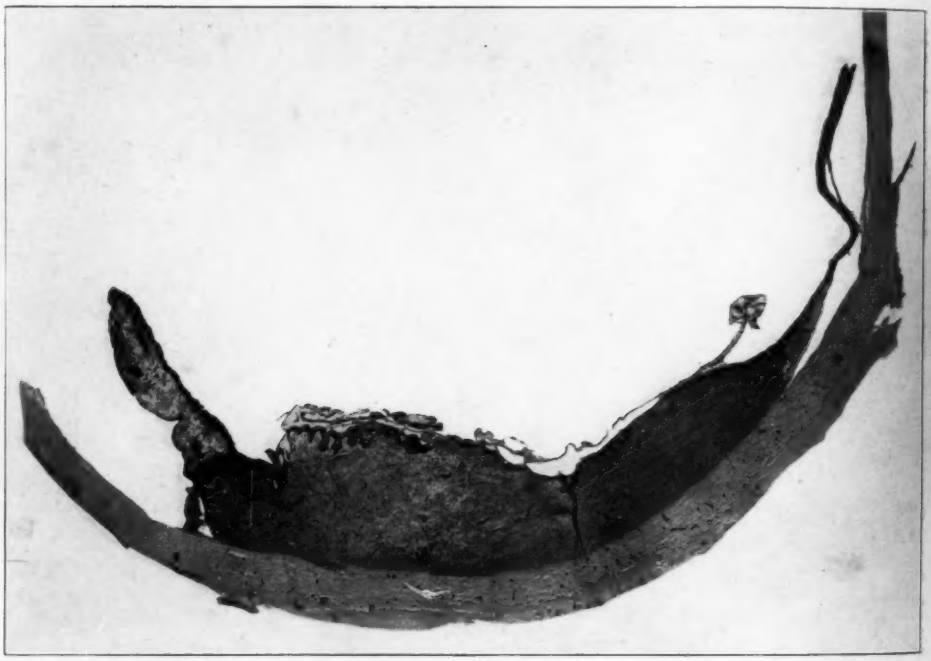

Fig. 2.—Tumor of the ciliary body. Reduced from a magnification of × 20.

isolated metastases in the ciliary body and iris without disease of the choroid are unusual (Cutler, Proctor and Verhöff, Uhthoff, Briehn, Paul).

Secondary carcinoma of the ciliary body is usually by continuity from the choroid and is rare.[2] When the localization is in the anterior part of the eye, the blood vessels involved must have been either an anterior ciliary artery or an emboli of a long posterior ciliary artery.

2. Parsons: Pathology of the Eye, New York, G. P. Putman & Son, 1904, vol. 1, p. 463.

Collins and Mayou [3] said that secondary carcinoma is often due to a process of permeation. The carcinoma cells at the seat of the primary growth extend into the lymphatics, then infiltrate and grow along these to surrounding parts. They also said that it has not yet been

Fig. 3.—Section of tumor of the ciliary body.

definitely determined whether metastatic carcinoma of the uveal tract is due to a process of permeation or to emboli of carcinoma cells, but they favor the former. In the case of the growth at the posterior pole,

3. Collins and Mayou: Pathology of the Eye, Philadelphia, P. Blakiston's Son & Company, 1925, p. 221.

the sheaths of the posterior ciliary arteries are the tracts along which it has extended, and in cases of the involvement of the anterior part of the eye one of the anterior ciliary arteries was probably the tract along which the growth entered the eye. The carcinomatous cells, having reached the lymphatic spaces of the choroid, proliferate in them, thickening the choroid without forming a localized prominence.

The choroidal metastasis occurs in the end-stage of the malady at the period of generalized carcinomatosis, so that the duration of life after the appearance of the metastasis is usually only a few months.

Suker and Grosvenor [4] at the annual meeting of the American Academy of Ophthalmology and Otolaryngology in 1908, after studying sixty-two cases of metastatic carcinoma of the choroid, found that death occurs on an average seven months after the onset of the ocular metastasis. Hirsch [5] was very much struck with the definiteness of the duration of life in these patients, and confirmed the observation.

The question of removing the eye does not have to be considered unless there is pain or the diagnosis is not certain. As the extension of a primary growth in the breast is by way of the pleura and the development of a tumor in the mediastinum, a roentgen examination of the thorax should be made.

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4. Suker and Grosvenor: Ophth. Record, 1908, p. 473.

5. Hirsch: Prag. med. Wchnschr., 1911, p. 631.

EXTENSIVE BILATERAL RETINAL DETACHMENT IN ECLAMPSIA, WITH COMPLETE REATTACHMENT

REPORT OF TWO CASES *

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The present report concerns two cases of extensive bilateral globular detachment of the retina with complete reattachment, occurring in eclampsia. Both cases were seen on the maternity service of the Hospital of the University of Pennsylvania. All patients with toxemia of pregnancy coming to the wards of this hospital from October, 1926, to December, 1928, a period of twenty-five months, were examined ophthalmoscopically. During this time, there were 1,024 deliveries; among these, there were 173 cases of late toxemia, an incidence of 16.9 per cent. Among the latter there were nineteen cases of eclampsia, an incidence of 10.9 per cent. This gives an incidence of 1.2 per cent for retinal detachment among the cases of late toxemia and of 10.4 per cent among the cases of eclampsia.

Schiötz [1] reported seven cases observed in a period of five years at the Christiania Clinic. During this time, 8,400 pregnant women were admitted, and of these 6,400 were examined ophthalmoscopically. Among these, there were 132 cases of eclampsia and 26 cases of threatened eclampsia. Clapp [2] examined all patients with albuminuria and toxemia for a period of fourteen years in the Maryland Lying-In Hospital, but the six cases of retinal detachment that he reported were observed within a period of sixteen months. Four of the five cases reported by Moore [3] were observed within a period of two years.

If one is to judge from the number of reported cases, detachment of the retina in toxemia of pregnancy is not frequent. Most of the reports have been of single cases. The first was that of von Graefe [4] in 1855. In 1902, Helbron [5] collected twenty-one cases. Moore,[3] in 1915, reported thirteen cases of detachment of the retina in nephritis,

* Submitted for publication, February, 1929.

* Read before the Section on Ophthalmology, College of Physicians, Philadelphia, Jan. 17, 1929.

* From the Department of Ophthalmology and the Department of Obstetrics of the Hospital of the University of Pennsylvania.

1. Schiötz, I.: Klin. Monatsbl. f. Augenh. **67**:66, 1921.
2. Clapp, C. A.: Am. J. Ophth. **2**:473, 1919.
3. Moore, R. F.: Roy. London Ophth. Hosp. Rep. **20**:262, 1915-1916.
4. Von Graefe: Arch. f. Ophth. **2**:202, 1855.
5. Helbron, J.: Berl. klin. Wchnschr. **39**:68 and 103, 1902.

and of these five were in nephritis of pregnancy. In addition, he collected twelve cases from the literature. Schiötz [6] reported three cases in 1919, and in 1921 [1] included these in his report of seven cases. He concluded that, with the six cases of Clapp,[2] there were fifty recorded cases. Blake [7] reported a similar condition in 1922, and made the statement that "apparently my own case makes a total of fifty-one examples of this interesting condition." Since 1922, I have collected four cases scattered through the literature, recorded one each by Benedict and Mussey,[8] Gardner,[9] Hill [10] and Schaanning.[11] These four cases with the two in the present report make a total of fifty-seven cases recorded to date. In the case reported by Hill,[10] bilateral retinal detachment occurred in two successive pregnancies, with reattachment following the first pregnancy, but with reattachment only in one eye following the second pregnancy.

REPORT OF CASES

CASE 1.—P. P., aged 36, colored, admitted to the hospital on March 20, 1928, had had four previous pregnancies, the last in March, 1926. These had progressed to term, and the labors had been normal. For one month previous to admission, she had had a moderate amount of edema of the extremities, which disappeared at night, but reappeared daily. For four days previous to admission, she complained of pains over her eyes and stated that she saw dancing objects before them. Her vision was blurred. On the afternoon of her admission, vision was lost, and shortly after this she had her first convulsion. When admitted, she was in coma, with marked general edema; and within the first six hours of her hospital stay she had five convulsions. Twins were delivered by podalic version that evening. The blood pressure was 235 systolic and 120 diastolic. The urine boiled solid with albumin. The blood urea nitrogen was 12 mg. per hundred cubic centimeters. The blood uric acid was 6.6 mg. per hundred cubic centimeters. The plasma contained carbon dioxide 32 per cent by volume. The van den Bergh direct reaction was delayed; the indirect reaction was 0.6 units. On the day following admission, the albumin content of the urine was 1.9 Gm. per liter. The blood count indicated a secondary anemia. The phenolsulphonphthalein test gave a total of 20 per cent in two hours. The Wassermann reaction of the blood was negative.

The first ophthalmoscopic examination was made on March 22. Vision was reduced to light perception in each eye. In the right eye, there was a globular, serous retinal detachment below, the upper part of which extended within 2½ disk diameters of the disk. In the left eye, there was a retinal detachment below, slightly more extensive than on the right, the upper part covering the lower half of the disk. In each eye, there were numerous hemorrhages and a number of soft,

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6. Schiötz, I.: Klin. Monatsbl. f. Augenh. **62**:234, 1919.

7. Blake, E. M.: Bilateral Detachment of Retina in Nephritis of Pregnancy, Arch. Ophth. **51**:586 (Nov.) 1922.

8. Benedict, W. L., and Mussey, R. D.: Am. J. Ophth. **6**:268, 1923.

9. Gardner, M. C.: M. J. Australia **1**:477, 1923.

10. Hill, E.: Bilateral Detachment of Retina in Two Successive Pregnancies, Arch. Ophth. **53**:137 (March) 1924.

11. Schaanning, G.: Norsk Mag. f. Laegevidensk. **86**:136, 1925.

A Summary of the Observations in Twenty-One Cases of Detachment of the Retina in Toxemia of Pregnancy

Observer	Case	Age	Patient	Detachment of Retina	Months of Pregnancy	Reattachment	Duration of Condition	Edema	Papillitis or Neuroretinitis	Vision		Visual Fields
Schiötz: Klin. Monatsbl. f. Augenh. 1921, vol. 67	1	29	Primipara	O.S.* only	6	Yes	2 days	Marked	Very slight	O.D. 6/6	O.S. 6/30	Concentric contraction
	2	35	Primipara	Bilateral	7	Yes	4 weeks	None	Very slight	O.D. 6/18	O.S. 6/36	Concentric contraction
	3	17	Primipara	O.D. only	Term	No	.....	Moderate	Papillitis; no retinitis			
	4	41	Primipara	Bilateral	8	Yes	3 weeks	None	Present	O.D. 6/24	O.S. 6/12	
	5	30	Primipara	Bilateral	7	Yes	6 weeks	Marked	Present	O.D. 6/24	O.S. 6/18	Concentric contraction
	6	22	Primipara	O.S. only	9	No	.....	Marked				
	7	25	Primipara	Bilateral	7	Yes	Still present O.S. after 8 wks.	Marked	None	O.D. 6/6	O.S. 6/6	
Clapp: Am. J. Ophth. 2: 473, 1919	8	35	Secundipara	Bilateral	6	Yes	Still present after 11 days	Marked	Slight	O.D. 20/30	O.S. 20/20	Normal
	9	31	.....	Bilateral	..	Yes	2 months	.....	Marked	O.D. 20/70	O.S. 20/30	Concentric contraction
	10	38	Quartipara	Bilateral	..	Yes	2 months	.....	Slight	O.D. 20/200	O.S. 20/100	Normal
	11	26	.....	O.D. only	9	Yes	9 days	Marked	Present	.....		Normal
	12	40	Duodecipara	Slight, O.D. only	8	Yes	2 days	.....	Present			
	13	33	Nonipara	Bilateral	..	Yes	3 days	Present	Present			
Blake: Arch. Ophth. 51: 586, 1922	14	31	Tertipara	Bilateral	7	Yes	9 days	Marked	Slight	O.D. 20/50	O.S. 20/100	O.D. normal; O.S. contraction above
Benedict and Mussey: Am. J. Ophth. 6: 268, 1923	15	25	Primipara	Bilateral	7	Yes	8 days	Marked	Slight	O.D. 20/33	O.S. 20/33	
Gardner: M. J. Australia 1: 477, 1923	16	33	Quartipara	Bilateral	6	Yes	14 days	Present	Very slight	O.D. 6/6	O.S. 6/6	
Hill: Arch. Ophth. 53: 137, 1924	17	..	Quartipara	Bilateral	6	Yes	.....	Marked	Marked			
	18	..	Quintipara	Bilateral	6	O.D. only	.....	Marked	Present	Blind		
Schaanning: Norsk Mag. f. Laegevidensk. 86: 136, 1925	19	..	.....	Bilateral	7	Yes	4 days	.....	Present			
Fry	20	34	Quintipara	Bilateral	9	Yes	3 months	Marked	Present	O.D. 6/9	O.S. 6/9	Concentric contraction
	21	20	Primipara	Bilateral	8	Yes	Still present after 12 days	Marked	Very slight	O.D. 6/12	O.S. 6/9	O.D. contraction above; O.S. normal

* O.S., left eye; O.D., right eye.

white exudates. By March 24, the detachments had increased so that a view of the disk could not be obtained in either eye. On March 27, in the right eye there was almost complete detachment; it extended forward below 12 diopters, and to the nasal side 6 diopters. The left eye showed similar conditions, with the detachment greater below. By March 29, reattachment had taken place everywhere except below, where it still measured 6 diopters. The disk was hyperemic and with obscured margins. There was some diffuse mottling in the macular region and about the posterior pole. Just above the disk, two large exudates and one small hemorrhage were noted. The arteries were bright and tortuous and at the crossings pressed the veins. In the left eye, similar conditions were found. Reattachment had taken place except in the periphery below, where the detachment measured 6 diopters. There was one flame-shaped hemorrhage at the temporal side of the disk. On April 12, vision was 6/15 in the right eye and 6/12 in the left eye. A small detachment still persisted in the lower periphery of each eye. The visual field showed a slight concentric contraction. The patient was discharged from the hospital on April 13. Three months later, when she returned to the outpatient department, her vision was 6/9 in each eye. There was no evidence of detachment, the disks were well defined and of good color, and there were no lesions of the choroid or retina.

Case 2.—C. H., aged 20, colored, admitted to the hospital on May 16, 1928, was a primipara, in the thirty-second week of pregnancy. She had been well until two weeks previous to her admission when an edema began, which became rapidly and progressively worse. On the day before admission, she complained of severe headache and blurred vision, and on the morning of admission she had her first convulsion. An extensive generalized edema was present. She was conscious, oriented and rational. The blood pressure was 170 systolic and 120 diastolic. She improved rapidly, so that in two days the edema, except for that of the face, had disappeared. At this time, the blood urea nitrogen was 18 mg. per hundred cubic centimeters; the blood uric acid was 4.7 mg. per hundred cubic centimeters; the plasma contained carbon dioxide 27 per cent by volume, and the fasting blood sugar was 125 mg. per hundred cubic centimeters. The urine showed a cloud of albumin and casts.

On May 25, the patient was delivered of a living, premature child. Early the following morning acute mania developed. The first ophthalmoscopic examination was made that day, May 26. There was marked edema of both lids, but greater over the outer portion. The conjunctiva was markedly chemotic at the temporal side in each eye and only slightly so at the nasal side. In each eye there was an extensive retinal detachment, globular in type involving the lower and temporal portions. Exudates or hemorrhages were not seen. By May 28, the patient was more rational. Vision was reduced in each eye to the ability to count fingers at 0.5 meter. The examination of the fundus on May 29 showed the disk to be dusky, and all about the posterior pole of the eye there was a moderate degree of edema, giving it a whitish appearance. The detachment was as noted before and extended forward 12 diopters. There was a well defined angiosclerosis. In the left eye, the disk showed the same duskiness, and the posterior portion of the fundus exhibited the same degree of edema. The detachment was mainly below and less sharply defined than that in the right eye. The upper portion extended to within 3 disk diameters of the disk and extended forward 12 diopters. There were no exudates or hemorrhages. By June 1, two days later, there was reattachment of most of the retina and a recession of the existing detachment, so that in each eye it was present in the lower periphery only and measured 4 diopters. There was a

small exudate adjacent to the disk in each eye. A slight peripheral detachment was still present on June 9. It measured 2 diopters. The patient was not seen again until Dec. 17, 1928, six months later. Vision was 6/15 in the right eye and 6/9 in the left eye. She stated that she had had difficulty in reading for four months following her delivery. Ophthalmoscopic examination revealed a slight pallor of the disk in each eye with some pigment disturbance in the adjacent choroid. There was no retinal detachment. The visual field in the right eye showed a contraction of 10 degrees in the upper temporal area; in the left eye it was normal.

COMMENT

Both patients exhibited marked generalized edema, as well as edema of the face and lids. An interesting feature of the second case was the marked chemosis and edema of the lids, which persisted after a complete subsidence of the generalized edema. In both cases there was a papillitis, but in the first exudates and hemorrhages were numerous and in the second they were scanty. The presence of edema would lead one to believe it to be important in causing the detachment. This coincides with the opinion of Blake, who stated in the discussion of his case that, "in view of the urinary findings, the detachments were only an expression of the marked edema due to impaired kidney function." Moore held that "edema does not produce detachment of the retina in the absence of nephritis." He further stated that "detachment of the retina is purely a local manifestation, which is dependent on the diseased condition of the retina and that the liability to its occurrence is in some measure proportionate to the severity of the retinitis." He believed that the immediate cause of the detachment was a subretinal exudate derived from the retina. Gourfein-Welt,[12] who examined two specimens from cases associated with nephritis, but not occurring in pregnancy, believed that the exudates were derived partly from the retina and partly from the choroid. Verderame[13] examined the eye in a case in which there had been bilateral detachment of the retina from nephritis of pregnancy one year previously. There was marked sclerosis of the choroidal vessels but little other change, and he believed that changes in the choroid, and not in the retina, were the cause of the detachment.

SUMMARY

In the accompanying table, I have listed twenty-one cases of this condition. Detachment is seen with about equal frequency in primiparas and multiparas; i. e., it occurred in nine primiparas and in eleven multiparas. It is usually bilateral; in fifteen of the twenty-one cases the condition was bilateral. The prognosis is good for reattachment; this

12. Gourfein-Welt, L.: Congrès periodique international d'ophthalmologie, 1904, p. 33.

13. Verderame: Klin. Monatsbl. f. Augenh. **49**:452, 1911.

occurred in eighteen instances. The prognosis in regard to vision is dependent on the residual changes from the accompanying retinitis and papillitis. Some degree of optic atrophy is frequently found. Reattachment was completed as early as the second day in two cases, the third day in one case and the fourth day in one case. Generalized edema is a notable feature. It was present in fourteen cases and was marked in ten. Some degree of papillitis or neuroretinitis was present in all the cases, being marked in two and slight in eight. The visual field after reattachment may be normal in extent or it may show some contraction, either concentric, or at one point, which need not coincide with the area of former detachment.

Ophthalmologic Review

THE AQUEOUS HUMOR

A CRITICAL REVIEW *

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The science of Galen prevailed until Andreas Vesaleus revealed by his dissection of the ocular tissue of man that the anterior humor of the eye did not resemble the white of an egg but was of a watery nature. Jacob Hovius (1702) some years later described the influx and efflux of this watery fluid in the anterior part of the eye. Since then a noteworthy amount of material has been written on the aqueous humor of man and animal, but a review of the literature discloses the fact that there is still little agreement as to the true nature and mode of formation of this intra-ocular fluid.

Several hypotheses have been presented to explain the mechanism of the formation of the aqueous humor. It is the consensus that the aqueous humor is derived from the circulating fluid—the blood and lymph—of the body. There is still some doubt as to whether the ciliary body and processes alone are the source of the formation of the aqueous humor. Likewise no definite decision has been reached as to whether the canal of Schlemn is the only means of exit for the fluid. Some experimenters believe that the aqueous humor is a stagnant body of fluid, whereas others describe it as a circulating medium. Obviously, a review of the literature may be a stimulation for further investigation of this subject.

MODE OF FORMATION

Three definite theories have been advanced for the formation of the aqueous humor. The supporters of the secretion theory have considered the ciliary body and its processes as the chief source of formation of the aqueous humor. The function of this ocular tissue has been likened to that of a true gland. From a histologic study of the ciliary region, pars ciliaris retinae, of the albino rabbit, Carrère found secreting cells entirely comparable to those described by Grynfelt in the choroid plexus of the brain which he considered as glandular. Seidel and Schmelzer likewise observed cytologic changes in the epithelial covering of the ciliary

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processess following cellular activity, which were considered by them as manifestations of glandular secretion. According to Scalini, the morphology of the ciliary epithelium reveals cellular activity characteristic of active cells usually found in many glands. Because of the chemical composition of the intra-ocular fluid he believed that the principal function of the epithelium of the ciliary body is to excrete an aqueous humor, but in view of the predominating idea that the aqueous humor is stagnant and is not being formed constantly, he assumed that, in man, a hormone is produced by the ciliary epithelium. The action of this hormone is to complete or reinforce the general formative energy and the nutrition of the tissues of the eye.

Further evidence of active secretion has been shown by Seidel by introducing pilocarpine and physostigmine into the ocular tissues. He found an increase in the size of the cell, which also differentiated itself into two zones, a granular area at the inner border and a clear zone at the periphery or free margin of the cell. This alteration in tissue has been interpreted by Becht and Weed as evidence of an increased amount of fluid passing through the cellular tissue.

Seidel assumed that physostigmine and pilocarpine increased the intra-ocular tension and protein content of the eye because the ciliary body is a true gland and the aqueous humor a true secretion. The increase in protein content has been noted by Kumagai, Mukai, Biagio, myself and others, but the observations are not in accord with Seidel's conclusions. Adler and Landis showed that the miotics produce the same effects on the tissue even after the ciliary ganglion is destroyed, and if atropine is introduced under the same conditions before physostigmine is instilled, no increase in protein is effective. They concluded that physostigmine produced an increase in protein content by acting on some structure other than the fibers of the third nerve running to the ciliary epithelium. Because of this observation they were unable to confirm Seidel's contention that the action of physostigmine is a proof of secretory activity of the ciliary epithelium.

Seidel and his group further supported their hypothesis by showing that there was a difference of electrical potential between the ciliary body and processes and the cornea so that a current was established as in the case of a secretory structure like the salivary gland. Lullies and Gulkowitch and Duke-Elder questioned this manifestation as a true glandular phenomenon. From a study of the intravascular pressure of the anterior ciliary arteries Seidel and his co-workers concluded that the ciliary pressure inside the eye is about 30 mm. of mercury. By deducting the colloidal osmotic pressure from this value, they estimated that the hydrostatic pressure responsible for the influx of the aqueous humor into the eye should be between 0 and 10 mm. of mercury. With an intra-ocular

pressure of about 25 mm. of mercury on one side of the membrane and a hydrostatic pressure in the capillary system of from 0 to 10 mm. of mercury, they believed that an inflow of fluid in the eye is impossible unless the presence of vital secretory forces is assumed.

FILTRATION THEORY

For many years the pressure filtration theory introduced by Leber, Henderson and Starling, and Parsons and corroborated by their respective schools has been advocated by many ophthalmic teachers. From his experimental work Leber concluded that the aqueous humor was produced from the blood in the ciliary processes and that it passed for the most part forward through the pupil into the anterior chamber and thence in the canal of Schlemn and anterior ciliary veins. He assumed that the fluid was slowly renewed by a simple filtration due to a difference of the hydrostatic pressure in the capillaries in the ciliary processes and the exit venous system—canal of Schlemn and anterior ciliary veins. This view was disputed by Weiss who maintained that Leber disregarded the difference in osmotic pressures of the blood and the aqueous humor. He noted that the pressure in Schlemn's canal was higher than that in the anterior chamber and therefore an outflow of aqueous humor into Schlemn's canal with normal intra-ocular pressure was out of the question. In particular he contended that movement of the fluid through the pupil was not proved, and that its production by one group of vessels and its absorption by another was not definitely proved. Hamburger also opposed Leber's theory on the assumption that no circulation existed in the eye. He believed that the fluid was stagnant and that its metabolism was carried on by a process of cellular interchange. He pointed out that lymph vessels can be demonstrated in the iris, cornea and posterior chamber by the method of Magnus and Stübel which rendered visible the vessels by filling them with peroxide. Because of the presence of this lymphatic system he contended that the canal of Schlemn was not the chief source of efflux of the aqueous humor. Hamburger noted that it required a pressure of from 40 to 50 mm. of mercury, on injecting the dye in the anterior chamber of the eye in living rabbits, to produce a coloring in the episcleral system. From his experimental observation, he concluded that the pressure in Schlemn's canal in the living animal must therefore be from 40 to 50 mm. of mercury as calculated by Weiss. Hamburger was also of the opinion that anatomically the canal of Schlemn is separated from the anterior chamber and hence not easily accessible to the outflow. He concluded from various experiments that there is no forward movement of the fluid through the pupil because of the presence of a physiologic barrier in the pupillary area and that the fluid in the anterior chamber came

from the iris and not from the ciliary processes. Hamburger did not deny a slight secretory activity of the ciliary processes for the scanty nutrition of the lens and vitreous, but the metabolism of the iris is more active than the ciliary processes, which are built on the type of the corpora cavernosa and have the static function to withhold the accommodative pressure of the lens from the iris and the cornea. Because the anterior and posterior chambers are separated by an absolutely water tight valvular closure (the iris-lens contact), he contended that the assumption of a filtration from the posterior chamber with the canal of Schlemn is impossible. He maintained that it was more important in normal conditions to have a healthy iris as a suction sponge with its pores directly immersed in the aqueous than a canal of Schlemn.

Seidel, replying to Stübel's work, refuted Hamburger's assumption of a lymph system and hence disagreed with his hypothesis. Seidel believed that no new proof of the existence of lymph vessels in the iris has been given. He used a somewhat different technic from that of Stübel and stated that while Schlemn's canal was lacking in the eye of the horse, its equivalent was represented by a delicate coronary venous plexus on the inner aspect of the sclera.

From a physicochemical analysis of the intra-ocular fluid, Duke-Elder stated the belief that the transudation theory is disproved by the fact that the intra-ocular fluids contain more negatively charged ions (chloride) than the plasma. His observations are substantiated by the chemical analyses recorded by Mestrezat and Magitot, Crevald, Asher, Gala, Wittgenstein and Gaedertz, Cohen, Killian and Metzger, myself and Tron. Their general analyses show that the ionized salts are unequally distributed in the two fluids—plasma and aqueous humor. Reviewing the work of the recent advocates of the stagnant aqueous humor, Priestley Smith pointed out that Leber's teaching as to the nature of the renewal process, was probably weak in one respect, that is, osmotic pressure of the blood, but as to the source, the pathway and the exit of the fluid, it is still unshaken and invaluable.

DIALYZATION THEORY

Analyzing in detail the experiments made to determine the formation of aqueous humor, Magitot arrived at the conclusion that the investigations so far conducted did not sufficiently reproduce normal conditions and that conclusions consequently did not apply to the normal aqueous humor. The renewal of the fluid was slow, and there was no true current in the anterior chamber of the eye. When the anterior chamber was emptied by puncture, the fluid filling the chamber consisted of serum transuded from the capillaries with an admixture of normal aqueous which was squeezed out of the meshes of the vitreous body.

From an embryonic study, he found that during the third and fifth month of embryonic life the first aqueous was a true secretion produced by special neuroglial cells and the aqueous humor in later life was only slowly absorbed and the deficiency was replaced by products of neuroglial cells, the cells of the ora serrata and the clear cells of the ciliary body. He maintained that the ciliary body possessed only a dynamic rôle in vision (accommodation) and that the structure of the processes was not particularly favorable to the mechanism of dialysis. The aqueous humor was formed in the eye by that which represents the pia mater and the nervous parenchyma—the uvea—principally the iris. Mestrezat observed from a chemical study, a parallel difference in the concentrations of individual substances in the cerebrospinal fluid and blood serum and concluded that the osmotic pressures of the fluids were approximately isotonic when measured by the freezing point. Later Magitot noted the same relationship to exist between the aqueous humor and blood serum which led him to believe that the aqueous humor issued from the blood serum by a dialysis according to a thermodynamic mechanism in which Donnan's equilibrium plays a rôle.

DeHaan and van Creveld, from their study of the sugar content in body fluids of the rabbit, concluded that the tissue fluids containing almost no colloids—aqueous humor and cerebrospinal fluid—generally showed a larger dextrose content than blood plasma. This phenomenon accorded with the theory that these fluids behave like a blood dialysate, which retained the sugar chemically bound, just as the dialysate in vitro. Later they also showed that intravenously injected fluorescein was present in the aqueous humor in exactly the same concentration relative to the plasma as they obtained by dialyzing blood through collodion membranes.

Lehmann and Meesmann, by means of a capillary electrometer and tenth-normal potassium chloride electrodes found that there was a difference of from 6 to 10 millivolts existing between the blood in the jugular vein and the aqueous humor. They also noted that there was an osmotic difference in blood and in the aqueous humor, from which observation they assumed that the aqueous humor was not formed according to Leber's view.

Duke-Elder, from a chemical study and a critical review of the subject, championed the membrane equilibrium theory enunciated by Donnan as applicable to the conditions of the fluid formation in the eye. Not only did the normal fluid obey this theory, but he found that the abnormal aqueous humor did likewise. He considered the capillary walls and not the ciliary epithelium as the essential dialysing membrane, because the intra-ocular fluids were in equilibrium with the capillary blood, the properties of the aqueous humor varied directly with the state

of their permeability, and the ciliary region was not the only site of the process of dialysis. In such a system he postulated "that there is a continuous process of reciprocal interchanges on either side of the capillary walls, made up of filtration outwards determined by the differences in the hydrostatic pressures, an osmotic flow in the opposite direction, conditioned by the relative osmotic pressures, a diffusion out or in of the diffusable substances according to their several differences in concentration and a readjustment depending on colloid impermeabilities, and that on either side of the capillary walls there is a balancing hydrostatic and osmotic pressure equilibrium, around which level the mutually compensating pressures are continually fluctuating, and in any capillary these balancing forces will determine a flow of fluid outward at one moment and inwards at another."

Magitot believed the aqueous humor to be stagnant. He considered the fluid a dialysate and located the dialysing membrane in the ciliary epithelium. He believed that there is a separate lymphatic system in the eye distinct from and never in contact or mixing with the aqueous. Magitot admitted that when diffusible substances are introduced into the aqueous, they spread by diffusion equally to all the tissues within the eye with which they come into contact and that nondiffusible substances readily obtain access to, and are actively eliminated by these paths. He further considered that the diastolic and systolic pressures in the entering arteries of the eye are 30 and 60 mm. of mercury, respectively, and that the capillary pressure is little above the intra-ocular. He considered the intra-ocular tension as a function of the state of turgescence of the choroidal blood vessels.

CIRCULATION AND SOURCE OF FORMATION

In addition to these references to a circulation in the eye, the following work must be considered: Weekers experimented on the eyes of pigs to determine the elimination channels of the aqueous humor. He demonstrated that in the pig, as in man, the elimination of the aqueous takes place in the region of the anterior chamber by a venous system situated in the sclerocorneal tissue, in the iris and in the ciliary body. Contrary to the conditions found in the human eye, an appreciable amount of the ink used for tracing the avenues of elimination in the rabbit passed out by way of the optic disk. Just as had been found in human beings, the rabbits' eye showed no trace of ink in the suprachoroidal space or around the choroidal or retinal vessels.

Carrère concluded that the iris takes no part in the production of the primary aqueous but that its posterior epithelium plays an active rôle in the production of the secondary aqueous. Hiroishi found the physiologic blood pressure in the episcleral veins and in the vortical veins to

be lower than the normal ocular tension. He satisfied himself that between the anterior chamber on the one hand and Schlemn's canal or the episcleral veins and vortical veins on the other hand there exists a hydrostatic reduction in tension and that the escape of the aqueous humor through Schlemn's veins is essentially produced by hydrostatic forces.

Nakamara, Mukai and Kosaki concluded from their experiments on the nutrition of the eye that normally the aqueous humor of the anterior chamber is secreted from the anterior surface of the iris, and the aqueous humor of the posterior chamber from the posterior surface of the iris or the ciliary body. With certain forms of irritation the aqueous humor passes through the pupil from the posterior chamber into the anterior chamber. Seidel commented on these experiments as supporting his own views on the circulation of intra-ocular fluid. Seidel stated the belief that under physiologic conditions of pressure there is a steady outflow from the anterior chamber into the veins of the chamber angle. This is due to a fall in the hydrostatic pressure between these spaces by reason of which the venous wall through which fluid passes acts as an ultramicroscopic filter. By injecting into the eyes of rabbits different dyes he found that Schlemn's canal was the natural channel for the flow of the aqueous from the anterior chamber. He noted that with a dilated pupil, a greater pressure was necessary to force the fluid into Schlemn's canal than with a contracted pupil. If the solution injected contained particles above a certain size, the filtration was blocked and the intra-ocular pressure increased, thus offering additional proof that there is a flow of aqueous into the anterior chamber as claimed by Leber. His views differ from Leber's in regard to the propelling forces which produce the fluid. He contended that the fluid is produced by a secretory force on the part of the ciliary epithelium and that the osmotic water-absorbing force of the blood proteins plays a considerable rôle.

Magitot and Dautrevaux, from a study of the composition of the aqueous in a case of complete seclusion of the pupil and in a case of congenital aniridia, confirmed the statement that in the formation of the aqueous humor the iris as well as the ciliary body takes part. In a recent review of the multiple sources of the aqueous humor, Magitot stated that normally there is no circulation in the proper sense of the word, the exit and entrance of the liquid being two phenomena which balance one another and are dependent on the nutritive demands of the nerve cells. Hydrostatic, osmotic, electric and chemical phenomena regulate this production and absorption. He contended that this assumption explains the entrance and exits of the aqueous humor under the various changes in the molecular concentration of the blood and sensory nervous stimulation.

Von der Heydt reviewed the work on the composition and currents of the aqueous humor and stated that there is normally a circulation of aqueous humor within the anterior chamber, thus verifying the conclusion of Türck that the aqueous humor rises near the warm iris and descends near the colder cornea.

From a slit lamp study of the anterior chamber, Trettenero found that the aqueous humor is subjected to a continuous rotary movement that ascends in the posterior part of the chamber and descends in the anterior. The cause of these currents is the inequality in temperature existing at various depths in the anterior chamber. By injecting india ink into the vitreous, Benoit was able to study the excretory channels of the eye in lower animals and also in two human beings. Venous spaces in the iris and in the ciliary body proved to be the most important channels of elimination. Except in the hen, the canal of Schlemn was found to be of secondary importance. In man, the drainage channels are much more restricted than in the lower animals, because the ciliary muscle is inserted farther forward and has attained a greater development, the spaces of Fontana being crowded back and more easily obstructed. D'Oswaldo noted that a current of green aqueous came through a gap in the pupillary margin of two cases of iris bombé when 2 cc. of uranium was injected intragluteally. He saw in these experiments a proof of Leber's theory of the formation of the aqueous in the posterior chambers.

According to Leboucq, the aqueous humor is produced intermittently and is controlled by the sympathetic system. He demonstrated the circulation by means of injecting 0.1 Gm. uranium in the ear of the rabbit. He showed that if fluid is stagnant, the Ehrlich line is not present. He does not believe that the aqueous humor leaves through the lumen of the anterior ciliary veins but through a perivascular lymph channel of the iris. Hagen stated that the regeneration of the aqueous under pathologic conditions differs from that in the normal human eyes, but is similar to that in normal eyes of animals, and that while in animals the regeneration takes place exclusively from the ciliary body, in the human eye it occurs chiefly from the iris.

It would seem from Duke-Elder's original work that he was in agreement with Magitot, Hamburger and Weiss in that the aqueous humor is stagnant because of his theory of formation, namely, "Theory of Dialysis." In his reply to Priestley Smith, Duke-Elder made clear his stand on the subject. He said:

> While holding that the aqueous humor is a dialysate, I maintain that a circulation does exist. It is only with regard to the cause of the circulation that we (Priestley Smith) differ. Priestley Smith considers that the circulation is "primary," determined by differences of pressure between the ciliary capillaries and the aqueous humor on the one hand, and the aqueous and the blood in the veins

associated with the canal of Schlemn on the other; while I suggest that there is a balancing hydrostatic and osmotic pressure equilibrium on either side of the capillary walls, which, as far as movement in mass is concerned, renders the aqueous humor "primarily stagnant," but which is continually being upset by changes in pressure occasioned by muscular action, the pulse beat, etc. While there is thus at all times a free passage of diffusible substances through the capillary walls with a readjustment depending on colloidal impermeabilities, there is superimposed upon the dialysate a secondary or (so to say) "pressure circulation," rendered possible by the delicately balanced pressure equilibrium at the canal of Schlemn. It is to be remembered that to all intents and purposes such a circulation will be continuous, although in actual fact the forces causing it act intermittently, and these will be quite capable of determining a flow of fluid so small as exists in the eye, a point upon which Priestly Smith rightly insists.

CHEMICAL COMPOSITION

A survey of the recent literature on the composition of the ocular fluids discloses the fact that the aqueous humor resembles the cerebrospinal fluid. Quantitative micro-analysis reveals a close relationship between the composition of the aqueous humor and the blood plasma in the various experimental animals examined. The results obtained, however, are variable in many instances. This is probably due to the analytic methods used in the determinations and the technic of obtaining the fluid from the eye.

For example, Osborne concluded that the aqueous humor was practically protein free. With the nephelometric method he found the protein content to be 0.09 per cent. Although he considered this result to be low, it was actually much higher than had been found by a large majority of investigators. Rados, using 90 per cent alcohol to precipitate the protein, was able to obtain only a trace of precipitate and he therefore concluded that there was almost no albumin in the normal aqueous humor. Later Rados, using the refractometer for determination and calculating the protein by means of a specific formula, found the values to vary between a trace and 0.017 per cent in the fluid of dogs' eyes. Seidel obtained higher values with the same method, but Rados believed that these results were due to Seidel's method of calculation whereby he ascribed higher values of protein to his refractometer readings. Rados noted that the fluid from the eyes of human beings and domestic animals showed comparable results in the protein determinations.

Lowenstein and Hamburger found that there was less protein in the eye of man than in that of the rabbit. The average result for rabbits' eyes was 0.025 per cent. Wessely and Fassin tested the sensitiveness of different protein reagents, and found that the best chemical methods are Esbach's and sulphosalicylic acid tests, and that much more reliable results are obtained by chemical methods than by refractometry.

They obtained results which varied between 0.02 and 0.04 per cent for the rabbit and between 0.01 and 0.02 per cent for man. The results have been corroborated by Gilbert, Mestrezat and Magitot and others. On the other hand, Hagen and Rados have disagreed with them. Wessely criticized the method of Hagen and Rados because they used 90 per cent alcohol as a precipitant, and he believed that this reagent was not satisfactory.

The results of Kumagai, who found the values of albumin to be between 0.02 and 0.04 per cent, agreed closely with those of Wessely. Seidel using his refractometric method and his own formula for calculation determined protein values which varied between 0.025 and 0.084 per cent. Adler and Landis and Wessely, however, criticized his method as being too inexact. Adler and Landis also used Wessely's "Esbach" method for determination of protein, but they did not find it satisfactory. The criticism was that erroneous results were obtained with the Esbach reagent. They finally adopted the nephelometric method as described by

TABLE 1.—*Composition of Aqueous Humor and Blood Serum in Horse as Found by Duke-Elder*

Gm. per 100 Cc. of Fluid	Aqueous Humor	Blood Serum
Total protein	0.0201	7.3692
Globulin	0.0123	2.9570
Albumin	0.0078	4.4125
Quotient: Globulin / Albumin	38.8/61.2	39.9/60.1

Denis and Ayer. Using the fluids of cats' eyes, they obtained values for protein which varied between 0.014 and 0.04 per cent, averaging 0.025 per cent. Gala found the concentration of protein in the anterior chamber in the eyes of healthy men and animals to be about 0.02 per cent. Dieter, by using his surface tension method, found from 0.01 to 0.024 per cent protein in the fluid of the eye.

My co-workers and I found 0.041 per cent per hundred cubic centimeters of fluid in the dog. This estimation was made by a modified micro-Kjeldahl determination on 0.2 cc. of aqueous humor taken from individual eyes of living animals. Cohen, Killian and Metzger, analyzing pooled fluid from horses and oxen, found by a macro-Kjeldahl method that the aqueous humor contained 0.0218 and 0.022 per cent, respectively.

In the horse, from which a large supply of aqueous humor was available, Duke-Elder found by a gravimetric analysis the results shown in table 1.

The quantities of pseudoglobulin and euglobulin were found to be too small to allow reliable investigation. He noted that similar figures were determined for the cow and the rabbit. In comparing the proteins

of the aqueous humor according to a method adapted by Hartley, Duke-Elder showed that the proteins in the aqueous humor are specifically identical with those in the blood. From his work and a review of the literature, he concluded that all the proteins of the plasma are found in the aqueous humor in the same relative proportion as they occur in the blood, and that they are specifically identical. He believed, therefore, that they remain unchanged in their passage from the blood vessels to the eye.

While on the subject of colloids, mention should be made of the presence of larger sized molecules, antibodies, hemolysins, precipitins, agglutinins, bacterialysins and opsonins in the aqueous humor. A survey of the work reported previous to the period which I am reviewing, discloses the fact that many authors were of the opinion that the larger molecules are present in the normal aqueous humor of highly immunized animals. Duke-Elder concurred with their previous observations and stated that the antibodies are present in the aqueous humor in the same proportion as one would expect to find on purely physical ground, and also in amounts corresponding closely with the concentration of proteins found there.

Several observers have also noted the presence of ferments in the normal aqueous humor. Jacinski believed the aqueous humor has a physiologically alimentary rôle because of the ferment which is present. Hayano found that glycolyse and invertase were not discernible in the aqueous humors of cattle, but that maltase was positive in them. The results of tests for lipase and lecithinase were negative in rabbits and cattle. He could not find pepsinase in the aqueous humor of cattle, by means of Gruetzner's or Fuld's methods. While tryptase could not be demonstrated in the aqueous humor of cattle and rabbits after Gruetzner's, Miller-Jochmann's or Fuld-Gross' methods, Hayano positively demonstrated its presence with the procedure of dialysis. The demonstrations of the autolytic ferments were positive in the aqueous humor of rabbits after the same method. Polypeptoid splitting ferment was not found in the aqueous humor of cattle. The results of tests for oxydase were also negative in the aqueous humor of cattle. Katalase was found neither in cattle nor in rabbits. Fibrin ferment was positive in the aqueous humor of cattle and rabbits.

According to most workers, the sodium chloride content of the aqueous humor is greater than that of the blood serum. Wessely obtained 0.7 per cent sodium chloride with rabbits. Magitot and Mestrezat noted similar results with the fluid of the eye of a horse; namely, 0.711 per cent. The results agree with those of Wessely. They also made determinations on normal human eyes, obtaining results which compared closely with those of the horse. In a series of experiments on the aqueous humor of domestic animals and man, they found that the

sodium chloride content was much alike. They showed that the fluid of the eye of a horse resembled the cerebrospinal fluid, being rich in sodium chloride and possessing little protein.

Ascher concluded that the chlorine ion was in greater concentration in the aqueous humor than in the blood serum, and that there must be a smaller concentration of other crystalloids in the fluid of the eye, for he assumed that the aqueous humor was isotonic with the blood. Ascher himself did not experiment with normal eyes, but from the work done by others he decided that the sodium chloride value of normal eyes averaged 0.7 per cent as compared with the sodium chloride of blood serum which was between 0.5 and 0.6 per cent. Using pathologic human eyes in which the anterior segment was normal, he obtained results which varied from 0.698 to 0.724 per cent. In another series of eyes he analyzed the fluid taken twelve hours after death and found that there was a marked rise in the sodium chloride content which ranged between 0.741 and 0.780 per cent. He also compared the sodium chloride content of blood serum and the aqueous humor in a group of patients and found that the blood serum had a concentration of from 0.590 to 0.611 per cent per hundred cubic centimeters as against from 0.708 to 0.718 per cent in the fluid of the eye. In all of his experiments he used the Bang method for determinations of sodium chloride. Rados, using the same method, obtained results on the aqueous humor of dogs, which varied between 0.586 and 0.685 per cent. He also analyzed the aqueous humor from human eyes. The results of the latter were almost the same as those found in the experimental animal. Leberman found 0.698 per cent sodium chloride in the fluid of the eye of a rabbit. Gala showed that the amount of total chloride was about from 0.7 to 0.73 per cent in the human eye. In domestic animals it oscillated within certain limits; in dogs and cats it was somewhat elevated and considerably lower in rabbits (0.63 per cent).

My co-workers and I, using a modified Ivor Bang method, found the sodium chloride content in the dog to be about 0.632 per cent per hundred cubic centimeters of fluid. Cohen, Killian and Metzger found the sodium chloride content in the ox to be 0.688 per cent and in the horse, 0.665 per cent. Duke-Elder estimated the salt content in the rabbit by Ruszynäk's modification of Koranyi's method, and compared it with the chloride content of both arterial and venous plasma. The sodium chloride content of aqueous was 0.637 per cent per hundred cubic centimeters of fluid, of arterial plasma, 0.619 per cent and of venous plasma, 0.589 per cent. It would appear therefore that the sodium chloride content is slightly higher in the aqueous humor than in the blood plasma.

The presence of sugar (reducing substance) in the aqueous humor has been known for many years; yet the estimated amounts present have

varied considerably. Osborne determined the dextrose content of the aqueous humor aspirated from the eyes of slaughtered oxen and found values varying between 0.6 and 0.12 per cent per hundred cubic centimeters of fluid. He used a Benedict method in his analysis.

Ask compared the amounts of sugar in aqueous humor with that of blood. His values for sugar in the fluid of the eye were from 0.12 to 0.15 per cent as compared with from 0.1 to 0.13 per cent for blood sugar. DeHaan and van Creveld, using Bang's method of sugar determination, obtained variable results for the total reducing substances. The values ranged between 0.05 and 0.28 per cent. They showed that the dextrose content of the fluid of the eye corresponded closely to that of the blood plasma; namely, from 0.12 to 0.3 per cent. They also noted that the sugar content of the aqueous fluid was greater than that of the spinal fluid, from 0.05 to 0.28 per cent as compared with from 0.02 to 0.2 per cent for the spinal fluid. Holi found that there was between 0.08 and 0.91 per cent sugar in the fluid of the eye of healthy men, while in their blood, the sugar content was between 0.08 and 0.095 per cent. In the aqueous humor of rabbits he found 0.116 per cent and in the blood there was 0.1 per cent sugar per hundred cubic centimeters of fluid. In all of his experiments, he used Bang's method.

Jess estimated the sugar content in the ox to be 0.075 per cent; Hayano, in cattle to be 0.06 per cent; Mestrezat and Magitot, in the horse, 0.094 per cent; in man, 0.09 per cent, and in the dog, 0.133 per cent. My co-workers and I determined the sugar content of the aqueous humor by several methods, but found the S. R. Benedict the best adapted for microdeterminations. The sugar content was estimated to approximate that of the blood plasma in normal conditions.

Duke-Elder estimated the sugar content of the aqueous humor, arterial and venous plasma, by the Hagedorn-Jensen method. He found 0.151 per cent in the aqueous humor; 0.158 per cent in arterial and 0.133 per cent in the venous plasma. It is apparent from these observations that the sugar content of the aqueous humor is approximately the same as that of the blood. Duke-Elder went one step further and called attention to the fact that the sugar concentration of the aqueous humor lies between that of the arterial and venous plasma and hence corresponds with that of the capillary plasma.

Concerning the other ingredients of the aqueous humor little has been done. The results which are recorded are estimated in various ways. Andresen found the urea in the aqueous sometimes above and sometimes below that in the plasma. Cohen, Killian and Metzger estimated the urea nitrogen in the aqueous humor of the ox as 0.008 per cent per hundred cubic centimeters of fluid. Duke-Elder, in the horse as 0.028 per cent; in the serum as 0.027 per cent; Mestrezat and Magitot in the horse as 0.046 per cent, and myself, in the dog, as 0.012 per cent.

Rados measured the amount of amino-acids in the aqueous humor. He obtained values which ranged between 0.06 and 0.24 per cent for the fluid of the eye of a dog. By the Folin method, I estimated the amino-acid nitrogen to be about 0.009 per cent per hundred cubic centimeters of aqueous humor. Cohen, Killian and Metzger found the aqueous humor of the horse to contain 0.004 per cent; Duke-Elder found it to be 0.029 per cent. In the ox, Cohen, Killian and Metzger estimated it to be 0.005 per cent per hundred cubic centimeters of aqueous. Practically all observers found that the creatinine content of the aqueous humor was approximately the same as that in the blood plasma. Wittgenstein and Gaedertz and Mendel and Goldscheider observed that the concentration of lactic acid varied somewhat from that of the blood. Mestrezat and Magitot estimated the inorganic sulphate and found 0.031 per cent in the horse. Duke-Elder determined the sulphates (SO_4) and

TABLE 2.—*Observations of Duke-Elder and Tron on Chemical Composition of Serum and Aqueous in Horse and Cattle, Respectively*

	Gm. per cent per 100 cc. of fluid in the eye			
	Duke-Elder		Tron	
	Horse		Cattle	
	Serum	Aqueous	Aqueous	Serum
Sodium	0.3351	0.287	0.147	0.156
Potassium	0.201	0.0189	0.00487	0.00795
Calcium	0.101	0.0062	0.0031	0.0056
Magnesium	0.0028	0.0026	0.000875	0.00133
Chlorine	0.3664	0.4371	0.123	0.112
Inorganic P (P_2O_5)	0.0030	0.0031	0.00177	0.00177
Inorganic S (SO_4)	0.0058	0.0061	0.00075	0.00187

found 0.0061 per cent in the horse; and Heübner and Meyer-Bisch found 0.006 per cent in the rabbit. Cohen, Killian and Metzger found the sulphates to be 0.0065 per cent in the horse and from 0.005 to 0.0075 per cent in the ox; I found 0.0003 per cent in the dog and Tron, 0.0012 per cent in cattle.

The inorganic phosphate (P_2O_5) was estimated by Mestrezat and Magitot as 0.0073 per cent per hundred cubic centimeters of fluid in the horse; by Duke-Elder as 0.0033 per cent in the horse; by Cohen, Killian and Metzger as 0.0014 per cent in the horse and 0.0054 per cent in the ox; by myself as 0.001 per cent in the dog, and by Tron as 0.0028 per cent in the cow. According to Kaneko the aqueous humor of the dog contains 0.002 per cent magnesium; Magitot and Mestrezat found 0.0018 per cent in the horse; Duke-Elder, 0.0026 per cent in the horse and Tron, 0.001 per cent in the ox.

From the results shown in table 2 it would appear that the cations are found in less concentration and the anions in greater concentration in the aqueous humor. Duke-Elder and Tron are both advocates of the dialysate

hypothesis and believe that the theory of the Donnan equilibrium is applicable to the aqueous humor.

PHYSICAL PROPERTIES

Except for the determination of the hydrogen ion concentration of the aqueous humor, comparatively little has been published during the last decade on the physical properties of the fluid. Duke-Elder estimated the solid matter in the normal aqueous humor of the horse to be 1.0869 Gm. per hundred cubic centimeters and the specific gravity at 15 degrees to be 1.0077. His results compare favorably with those of the earlier observers, which Steindorf recorded.

REFRACTIVE INDEX

Vladescu and Babes determined the index of refraction of the aqueous humor of ox eyes which were brought from the slaughter house to the laboratory, with a Zeiss-Pulfrich refractometer. Their results were fairly constant, varying between 1.33520 and 1.33532. Lowenstein estimated the index of refraction of the fluid of the eye of rabbits under normal conditions, at a temperature of 17.5 C., and found it to be between 1.33585 and 1.335418. He found that prolonged instillation of cocaine has no effect on the index. In the eyes of human beings he found the refractive index to be between 1.33513 and 1.33521. Freytag studied the refractive index in cats and rabbits and observed that it was practically the same for the aqueous and the vitreous humor and that it did not change with the age of the animal. He thought that the variations of index ascribed to age may have been due to the length of time elapsing after death before the fluid was examined. His results for the index of refraction of the aqueous humor in cats' eyes averaged 1.3295. Seidel, working with cats, obtained a refractive index of from 1.3353 to 1.3359. Osborne using ox eyes, determined the refractive index with a Zeiss refractometer at 17 C. to be 1.336 and in the serum to be 1.3451. Rochon-Duvigneaud and Mawas examined the aqueous humor of the owl and found a refractive index of 1.336. Wessely obtained a refractive index for the fluid of rabbits' eyes which varied between 1.33513 and 1.33533. I employed the Zeiss-Pulfrich refractometer in my determination of the refractive index at a temperature of 17.5 C. and obtained a refractive index which ranged from 1.33505 to 1.33551. In a series of normal rabbits' eyes I obtained a refractive reading of from 1.33505 to 1.33567.

REACTION OF AQUEOUS HUMOR

Of the work done on the hydrogen ion concentration of the aqueous humor, that of Hertel stands out as most prominent and important. Using the m-nitrophenol indicator technic as developed by Michaelis, he

made a number of determinations on the hydrogen ion concentration of the aqueous humor. At a temperature of from 18 to 20 C. he found the hydrogen ion concentration of the eyes to vary between 7.32 and 7.53. Again, in another series of experiments, using eyes having an increased intra-ocular pressure he found the p_H to be much the same; namely, between 7.32 and 7.65. His criticism of the method is that m-nitrophenol itself is an acid and has a tendency to lower the hydrogen ion concentration. To prove this he diluted the fluid of eyes with physiologic solution of sodium chloride, and the increased dilution of the fluid of the eye resulted in less alkalinity. In another series of experiments Hertel found that the p_H of the undiluted aqueous humor of the rabbit was 7.7.

Meesmann called attention to the fact that Hertel had proved that the p_H was constant within normal limits and that there was practically no difference between the hydrogen ion concentration of the normal and diseased eyes as measured by the differences in intra-ocular pressures. Meesmann, using Michaelis' indicator method, agreed with the results of Hertel, namely, that the p_H of the fluid of a rabbit's eyes was 7.7; Nordenson also obtained results similar to those of Hertel and Meesmann. He used the colorimetric method of Felton with a 50 per cent alcoholic solution of creolsulphonphthalein. In all cases, the examination was made on eyes of cows after death. His results for the hydrogen ion concentration of the fluid of the cow's eye averaged 7.65. Believing these values to be somewhat high, he explained that they were relative and not absolute. He also found that there is no important difference between the hydrogen ion content in the fetus and that of the cow. Baurmann, using Hober's electrometric method, found that the p_H of the aqueous humor was 7.495, while that of the cerebrospinal fluid was 7.5 in the rabbit. He did not report his observations on the aqueous in man but stated that it is normally richer in hydrogen ions than is the aqueous in normal rabbits. Goldschmidt introduced the carbon dioxide factor in calculating the hydrogen ion concentration. Kronfeld's experiments on the hydrogen ion concentration of the aqueous humor indicated that it did not differ from that of the blood. Mawas and Vincent estimated the p_H of the rabbit by an electrometric method. With this procedure they noted that the hydrogen ion concentration of the aqueous humor in rabbits varied between 7.52 and 7.55 and agreed fairly well with that of the blood. By the Van Slyke method they determined the alkaline reserve to be about 70, whereas the blood was 45 per cent by volume.

The total carbon dioxide content was high and approached 70 per cent by volume, whereas that of the blood was about 50 per cent.

With the cryoscopic method, Osborne found the aqueous humor isotonic with the blood serum in the ox. Dieter, experimenting on the

rabbit and using a microapparatus, observed that in three experiments the aqueous was isotonic in one and hypotonic to the serum in two. Van der Hoeve and Mestrezat considered the aqueous humor and the blood serum essentially isotonic; and Duke-Elder, by means of a micro-osmometer, noted that it corresponds to that of a dialysate of the blood in the arterial capillaries.

Dieter estimated the surface tension with a capillary viscometer and found it to be from 72.4 to 73 dynes per centimeter at 18 C. Van Creveld, using the static method of Brinkman and Dam, noted that the aqueous humor had a surface tension greater than plasma and less than water. The viscosity of the aqueous humor in the dog was found by Scalini to be greater than that of water and less than that of the blood. Cohen, Killian and Kammer found the viscosities of the cerebrospinal fluid and aqueous identical and slightly above that of water. Guglianetti reported that the viscosity of the aqueous humor in rabbits' eyes was almost the same consistency as distilled water.

The conductivity of the aqueous humor was found to be greater than that of serum. Van der Hoeve found the conductivity to be the mean between the dialysate of the arterial and the venous blood. Duke-Elder likewise concluded that the conductivity of the aqueous humor is less than that of the blood serum.

CONCLUSION

It is apparent from a review of the literature that the aqueous humor, of the animal at least, is a colorless fluid with a specific gravity of from 1.003 to 1.008, the p_H of which is slightly greater than that of the blood plasma. The chemical composition reveals the fact that it is extremely poor in protein. All of the proteins of the plasma are found in the aqueous humor in the same relative proportions as they occur in the blood and are specifically identical. The sodium chloride content is greater in the aqueous humor than in the blood plasma. It has also been shown that the anions in the aqueous humor are greater than the cations when compared with the blood plasma. The aqueous humor is derived from the blood stream through the vascular wall and intervening tissue of the eye. It is in constant circulation, but there is no unanimous agreement concerning the propelling force responsible for this motion.

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Correspondence

"DIAGNOSIS AND TREATMENT OF CEREBRAL TUMORS"

To the Editor.—After reading in the March number of the ARCHIVES OF OPHTHALMOLOGY the abstract of the article by J. Bollack and E. Hartmann on the diagnosis and treatment of cerebral tumors, I consulted the original article in the *Annales d'oculistique,* and found that the ARCHIVES gives a slightly abbreviated translation of what Bailliart reported in that periodical, and does not convey a clear idea of the statements made by the original writers.

Impressed by the dithyrambic introduction, I hoped to find something new, but have been disappointed. This would not have induced me to write to you, were it not for the fact that, besides an error of the translator in substituting "cause" for "result" (first word of line twelve of the text), I notice this statement: "The modifications of the optic disk start at the margin (blurring, hyperemia); they are especially marked at the temporal side and much more difficult to recognize at the nasal side."

This is so different from what our German confrères have published about the beginning of the choked disk that I wish to refer to E. von Hippel's contribution, "Die Krankheiten des Sehnerven," in the second edition of the Graefe-Saemisch "Handbuch," 1923. In it von Hippel points out the great value of the binocular examination with the great Gullstrand ophthalmoscope, and on pages 16 to 18 says: "Uebereinstimmend ist wohl die Erfahrung aller Beobachter, dass die stärkste und früheste Schwellung vorwiegend oben und unten zu sehen ist, das heiszt da, wo die stärksten Gefässstämme übertreten. In den Stadien, von denen hier die Rede ist, bleibt man bei der gewöhnlichen Untersuchung oft genug noch im Zweifel, ob überhaupt eine Schwellung der Papille vorliegt, während die stereoskopische Betrachtung so absolut eindeutige Resultate in dieser Hinsicht liefert, dass man immer wieder über den Unterschied erstaunt. . . . In allen Stadien der Stauungspapille lässt sich nachweisen, dass die Schwellung des temporalen Drittells hinter der der übrigen Teile zurückbleibt."

Who is right? Cannot American neuro-ophthalmologists control these observations?

E. E. BLAAUW, M.D., Buffalo.

Notes and News

EDITED BY DR. GEORGE S. DERBY

SOCIETY NEWS

Sixth Postgraduate Course in Ophthalmology in Vienna.—The sixth special course for postgraduate study in ophthalmology will be given between Oct. 1 and Dec. 6, 1929, under the auspices of the American Medical Association of Vienna, at the I and II Eye Clinic of the Allgemeines Krankenhaus, Vienna, Austria.

The course has been so arranged that the field can be covered systematically and comprehensively in the allotted time. A preliminary knowledge of ophthalmology is presupposed.

The entire course is given in English for a minimum of ten and a maximum of sixteen men. The fee is $244. Applications with certified check for $50 on account should be sent to Docent A. Fuchs, Vienna, VIII, Skodagasse 13. Applications will be accepted in order of priority.

Further information can be secured by writing to Docent Dr. A. Fuchs, at the address mentioned, or to the American Medical Association, Vienna, VIII, Alserstrasse 9, Café Edison.

DEATH

James Moores Ball.—Dr. James Moores Ball of St. Louis died on March 1, of heart disease, at the age of 67.

Obituary

ARTHUR EUGENE EWING, M.D.
1855-1929

Arthur Eugene Ewing was born in Cartersville, Ga., April 6, 1855, and died of cerebral hemorrhage in St. Louis, Jan. 26, 1929.

When he was very young, his father, a physician, removed with his family to Gadsden, Ala., where he acquired a large practice in the town and surrounding territory. As he was a stanch Abolitionist and a follower of Abraham Lincoln, his life, in that time and environment, was far from easy.

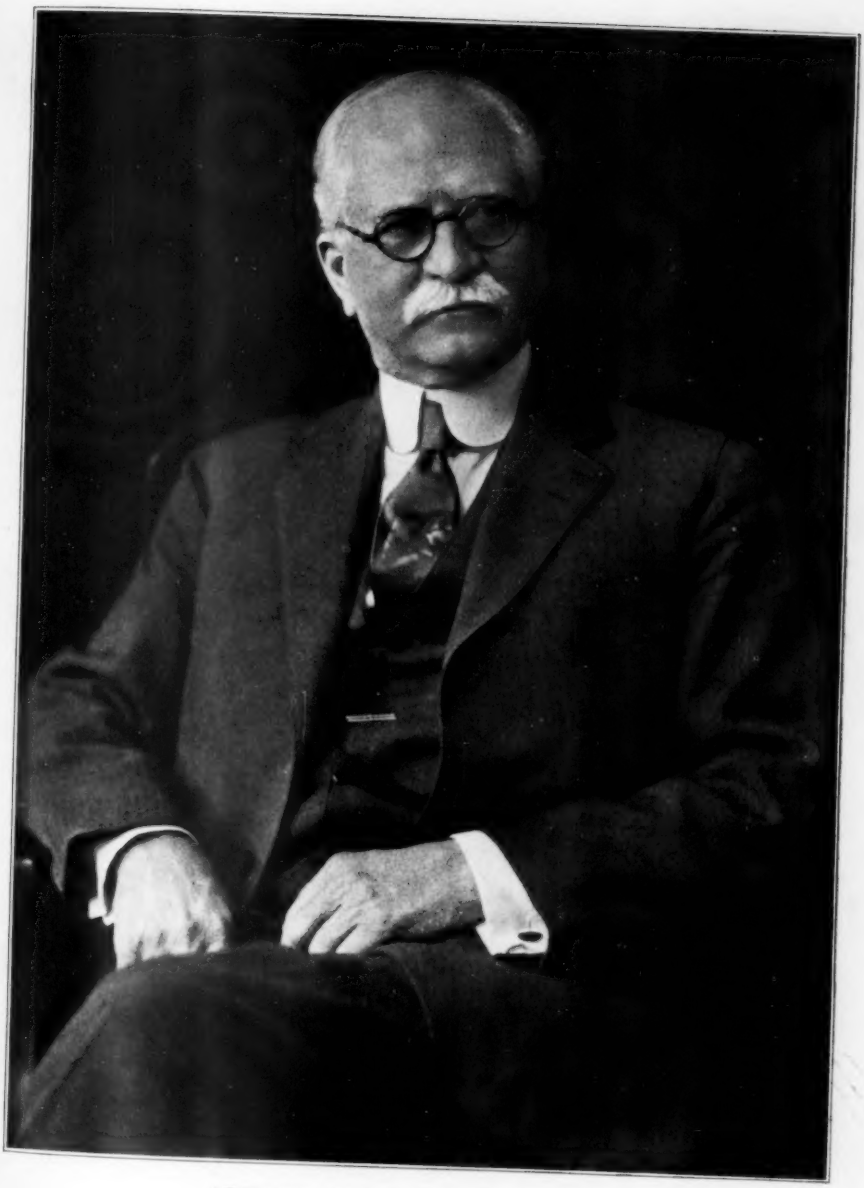
The boy's early education was somewhat fragmentary, and when he entered Dartmouth College he encountered difficulties due to the lack of adequate preparation. With characteristic determination, he overcame scholastic handicaps, and graduated in 1878 among the leaders of his class.

On his return to Gadsden, he became principal of a public school and studied law in his spare moments. In 1879 he was admitted to the bar, but soon became convinced that he had neither liking nor aptitude for a legal career.

In 1880, he entered the St. Louis Medical College (now the Washington University School of Medicine), thus following in the footsteps of his father, who was an alumnus of this institution, and received the degree of Doctor of Medicine in 1883.

Even in his student days he became interested in ophthalmology and spent much time in the offices of Drs. John Green and M. H. Post. After graduation, he served as Dr. Green's assistant for four years. From 1886 to 1888, he studied clinical ophthalmology and ophthalmic pathology under Professors Voelckers and Fleming at the Königliche Christian University in Kiel, Germany. On his return to St. Louis he renewed his former associations and eventually formed a partnership with Drs. Green and Post, which endured until the death of the oldest partner in 1913.

Dr. Ewing never spared himself in attaining an end; to acquire a speaking and understanding knowledge of German, he took his meals with a German family in which English was never spoken and took part in amateur plays in the German language. He was gifted with mechanical ability and had much skill as a carpenter. Always interested in operative work and appreciating the advantages of ambidexterity in ophthalmologic operations, he fashioned an elaborate doll's house for the daughter of his senior associate, forcing himself to use hammer, saw,



ARTHUR EUGENE EWING, M.D.

1855-1929

chisel and other tools with his left hand. His mechanical ingenuity found an outlet in the devising of a number of instruments, notably a capsule forceps with opposing surfaces shaped like bread knives, a simple and efficient speculum, a double fixation forceps and a lip clamp.

His European training gave him a love for ophthalmic pathology, and while the demands of his practice never permitted him to indulge in this branch as much as he would have liked, nevertheless, he made a number of important contributions.

In conjunction with Dr. Greenfield Sluder, he was a pioneer in establishing the relation of accessory sinus disease to certain functional disorders of the eye, and was the first to describe an area of tenderness in the fronto-ethmoidal region—Ewing's point—which is diagnostic of so-called vacuum sinus headache.

He devised and published an excellent series of pictographs for testing the vision of children and illiterates.

He would never delegate to a nurse or an assistant the preoperative preparation of a patient, and as his technic was elaborate, it was not unusual for him to spend fully two hours in this work. His extreme care in this preparation, coupled with a steady hand and scrupulous attention to asepsis, yielded a high percentage of successful surgical results.

His patients quickly realized his utter devotion to their interests, and he acquired and held an ever increasing clientele even to the last week of his practice.

He held successively various teaching positions in the department of ophthalmology in the Washington University School of Medicine and was head of the department from 1902 to 1921, when he became emeritus professor.

He was interested in certain phases of entomology and was granted the degree of Master of Arts in this subject by Washington University in 1912. In 1926, the same university gave him the honorary degree of Doctor of Science.

One of his dreams, which he lived long enough to know would be realized, was the establishment of an ophthalmic hospital and department for ophthalmic research in St. Louis.

His widow, Josephine Willard Ewing, and two daughters, Margaret Frances and Charlotte Eugene, survive.

JOHN GREEN.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Physiology

A STUDY OF THE FACTORS CONCERNED IN DEPTH PERCEPTION. A. W. LOY, Am. J. Ophth. **12**:108 (Feb.) 1929.

The author concludes that depth perception requires normal central vision, normal peripheral fields and equipoise. Accommodation and convergence depend on muscle or tendon sensation, and aid only in gross determination of depth. Convergence is most useful in depth perception (1) in establishing a horopter which separates crossed from uncrossed diplopia, and (2) in placing corresponding retinal areas in relative positions from which may be determined the relative positions of objects or points in the field of vision the images of which fall on these retinal areas. The positions of these retinal areas are conveyed to consciousness by "specific nerve energy," and this is of the greatest importance in depth perception.

W. S. REESE.

THE PRESSURE EQUILIBRIUM OF THE EYE. W. S. D. ELDER, J. Physiol. **64**:78, 1927-1928.

Following the work of Parsons, Henderson, Starling and others, the author has experimented on the relation between intra-ocular pressure and the blood pressure in the ocular circulation. He points out that it is well known that changes in general blood pressure, experimentally produced, result in qualitatively similar changes in intra-ocular pressure. This similarity is so striking that some investigators have been led to believe that there was no other regulating mechanism for intra-ocular pressure.

Under the conditions of such experiments, however, the osmotic pressure of both blood and aqueous humor remains unchanged. The present experiments were undertaken to determine the influence of this factor in inducing variations in the pressure equilibrium of the eye. Cats were used throughout the experiments. They were anesthetized with chloralose. Intra-ocular pressure was measured by a compensated mercury manometer with an air bubble in a horizontal capillary tube. This is an index of equilibrium similar to the apparatus of Henderson and Starling. Blood pressure was registered by a mercury manometer connected with the carotid artery.

A series of experiments showed that if the composition of the blood was altered without, however, changing its osmotic pressure (bleeding from a femoral artery and replacing the volume with an osmotically equivalent amount of gum arabic in Ringer's solution) the intra-ocular pressure showed no variation. Further, when the blood pressure in such a preparation was altered, the intra-ocular pressure responded by similar changes as in the intact animal.

A second series was tested in which, after bleeding, the volume was made up by a 15 per cent solution of gum arabic in tap water. Although the intra-ocular pressure followed the blood pressure closely at first, it soon began to fall steadily, independently of the latter. By the addition of the solution of gum arabic, the colloid content of the blood plasma was greatly increased. Since, however, no colloidal particles had passed into the aqueous humor (proved by simultaneous estimations of the refractive index of the aqueous of the opposite

eye) the difference in the osmotic pressures of aqueous and blood was necessarily increased, and the intra-ocular pressure, the level of which depended on the capillary pressure less this difference, consequently fell.

Similar experiments in which the blood colloids were diluted showed a rise in intra-ocular pressure independent of the blood pressure since the difference between the osmotic pressures of aqueous and blood was diminished. The author also varied the colloid content of aqueous humor by allowing a solution of gum arabic to replace the normal aqueous. The intra-ocular pressure rose steadily, due presumably to the colloid osmotic pressure of the aqueous approximating that of plasma and causing the intra-ocular pressure, therefore, to rise toward the level of the capillary blood pressure.

He concludes that as far as these experiments go they confirm the hypothesis that the aqueous humor is a dialysate of the capillary plasma. The influence of other variants which alter the volume pressure of the eye also was pointed out. The author regards the canal of Schlemm as a safety valve mechanism which in normal circumstances deals adequately with alterations in the pressure circulation of the aqueous humor and counteracts, to some extent, the changes of volume pressure which may occur in the eye.

F. H. ADLER.

THE MOVEMENTS IN THE EYES IN READING. M. D. VERNON, Brit. J. Ophth. **12**:130 (March) 1928.

It was thought at one time that in reading the eyes move backward and forward smoothly and continuously, and that perception of the words takes place during the movement. But since 1878, observers have found that movement takes place in a series of jerks, with a pause after each movement during which the eyes are relatively at rest. Only during the backward sweep of the eyes from the end of one line to the beginning of the next is movement smooth and regular. It was observed that the short, jerky, forward movements are rapid and that the pauses during which the eyes are fixed on the print are about ten times greater. The literature on the subject is reviewed, and the results of several investigators are tabulated.

The number and duration of the pauses vary considerably for different subjects and different types of reading matter. The variation depends chiefly on the material read, familiarity with the text and length of the line of print. The number of words per fixation is greatest for a line from 5 to 6 cm. long. Lines not more than 8.5 cm. long are least fatiguing. Familiarly associated words and well known phrases are read at a single fixation.

Readers have a tendency to form "short lived motor habits." These habits are dependent on the maturity of the reader, the ease and familiarity of the material and the regularity of the print; they are not formed if the lines are of unequal length or the margins irregular. The most efficient readers have few, though sometimes long, pauses.

It was concluded that no perception takes place during movement. The horizontal plane seems to have become habitual to the eyes, and they rarely stray above or below the line of print. The eyes diverge during the interfixation movements and converge during the pauses.

The perceptual span is not dependent on visual field, visual acuity or visual sensitivity, but is rather dependent on the rate of central assimilation of the meaning of the material read. But the movements can nevertheless be regulated both by direct training in the physiologic processes, and by means of the printing and general lay-out of the material read.

A. COWAN.

EXPERIMENTAL STUDIES OF THE LACRIMAL PASSAGE. K. G. PLOMAN, A. ENGEL and F. KNUTSSON, Acta ophth. **6**:55, 1928.

A study of the mechanism of the lacrimal apparatus was made by injecting iodized poppy seed oil 40 per cent into the lacrimal sac. X-ray pictures of this injection revealed the outline of the sac and the nasolacrimal duct clearly. It was noted that in forcible contraction of the orbicularis muscle the shadow of the sac undergoes a characteristic change in shape, its upper end either expanding or remaining as before, while the lower end becomes narrower, and the nasolacrimal duct under the same conditions also becomes narrower.

By special volumetric experiments, the authors showed that the movements of winking as well as those of forcible contraction lead to a decrease in volume of the lacrimal passageways. Contraction induces a greater change in the level of liquid than the movement of winking, and they assumed that the changes of volume in the sac and the duct are not qualitative but quantitative.

Cinematographic records of the volumetric experiments, and analyzation of the various phases of the movement have shown a definite relation between the decrease in volume and the movements of the eyelids, in that the decrease begins simultaneously with the contraction of the orbicularis, and ceases when the muscle is relaxed. In other words, it is the closing phase of the movement of the eyelids which leads to a compression of the tear sac and the upper part of the nasolacrimal duct, which parts expand again when the eyes are reopened.

A. M. YUDKIN.

Congenital Anomalies

PSEUDO-GLAUCOMA. A. MACRAE, Brit. J. Ophth. **13**:63 (Feb.) 1929.

This condition was seen in a healthy girl, aged 14 years. Capillary nevi covered the large part of the forehead and face, and small areas were scattered over the body. The right hand and arm were noticeably larger than the left. The vision equalled 6/6 in the left eye and light perception in a limited area of the temporal field in the right eye. The tension was normal in each eye. In the right eye the optic disk was smaller than normal and roughly rectangular, with the longer sides horizontal. The margin formed the overhanging edge of a deep goblet-shaped cavity. The overhang was so great that it was impossible to follow the vessels to their junction with the central vessels in the depths of the cup. In the floor of the cup, which was 5 diopters in depth, the lamina cribrosa was clearly seen in an area occupying its upper third. Below and to the nasal side of this, two vessels emerged. On the floor of the cup there was no difference in color between the arteries and veins. The condition is argued to be a congenital abnormality and not glaucoma.

W. ZENTMAYER.

Methods of Examination

FURTHER REPORTS ON ROENTGENOGRAPHY OF THE ANTERIOR PORTION OF THE EYE WITHOUT THE BONY PARTS AFTER THE METHOD OF VOGT. ST. WIESER, Klin. Monatsbl. f. Augenh. **81**:234 (Aug.-Sept.) 1928.

This article is based on the publications of A. Vogt (*Schweiz. med. Wchnschr.* **51**:145, 1921) and of Haemmerli (*Klin. Monatsbl. f. Augenh.* **74**:*681,* 1926). Illustrations are appended.

The method is devised for the detection and localization of minute intra-ocular foreign bodies not detected or localized by other methods. It will not replace the usual roentgen examination of the skull entirely, but it is especially indicated when the presence of a small particle is suspected and the usual roentgen method had

failed to show it and when the particle consists of a soft substance which allows the strong rays, required for skull exposures, to pass through it, e. g., glass or stone. The author claims that this kind of particle cannot be detected by any other method; when the presence of the particle has been established but localization is impossible, this method is also indicated.

The method permits accurate localization within the fraction of a millimeter at a depth slightly behind the equator of the globe or even deeper in patients whose eyes are not too deep-seated. This is sufficient to reach minute particles which, owing to their small force, rarely penetrate deeper into the globe. The method covers the ciliary region. Two small shovel-shaped films, encased in a light-tight wrapper, repose on a layer of slightly flexible lead foil of the same size and shape. This double film is necessary as a control measure; the foreign body must show on both of them. A shadow showing on only one of them would be due to errors or contaminations. The films are fastened to a spoonlike appliance, attached to a wooden handle, which is the shape of the film but which is 1 cm. shorter, allowing the film to protrude in front. By this arrangement the deeper regions can be reached, and the hand, covered with gloves of lead-rubber, may remain out of reach of the rays. A small screw at the distal end of the handle will prevent the films from slipping. A diagnostic tube with a sharp focus may be used in any apparatus, even in the small ones employed by dentists. It is advisable to add to the tube a tubus, 30 cm. long and from 6 to 7 cm. in diameter, as it will permit control of the angle made by the direction of the rays and the patient's gaze; it will limit, also, the area exposed to the rays. An aluminum filter of 0.5 mm. is added to eliminate the very soft rays. The conjunctiva being anesthetized, the patient rests on a table with his face turned away from the tube while a bitemporal exposure is taken. The lids are kept apart by plaster strips attached to the forehead and cheeks. The tube, placed at an angle of 30 degrees to the vertical bar, is brought within a few centimeters of the eye in a manner that will allow one fourth of the area illuminated by the tubus to rest on the temporal margin of the orbit and three fourths of it on the eye itself. The exposure is taken after the film holder is gently pushed from the nasal canthus, along the globe, into the conjunctival sac. Five exposures are taken while the patient is advised to look straight ahead, then in the extreme temporal, nasal, upper and lower directions, respectively. It is essential to watch the position of the holder. The exact location can be established by the insertion of Vogt's small metal marks into the conjunctiva and then taking a vertical exposure while the patient is sitting in a semireclining position, his chin almost resting on his chest. This time, the film holder is placed inside the lower lid and pushed along the floor of the orbit; the patient is told to look straight ahead. It is necessary to exert special care in placing the tube and the head in such a position that the central ray will touch the curvature of the cornea in a tangential manner. This will facilitate the elimination of the shadow of the upper orbital margin, even in deep-seated eyes. Vogt's metal marks are very fine sterilized fishhooks, the stem of which has been clipped short. They are placed into the conjunctiva with their convex curvature turned toward the limbus and as close as possible to the site of the foreign body, the presence of which has been established. The location of the hooks is marked in a pencil sketch. Fresh perforations are allowed to close before an exposure is taken.

The usefulness of this method was shown in the report of five cases, in which three eyes harbored splinters of iron and one copper and feldspar, each, respectively. Their sizes ranged from 1.5 to 0.9 mm. in length and from 0.5 to 0.1 mm. in thickness. Extraction was accomplished readily in each case; irritation or damage

done by the films was not observed. Stereoscopic or other measurements are not required in the employment of this method. A description is appended of Vogt's hitherto unpublished operative procedure for exposing the ciliary body which was used in the three cases in which the eyes harbored a splinter of iron.

K. L. STOLL.

Experimental Pathology

A HISTOLOGICAL STUDY ON THE ACTION OF SHORT-WAVED LIGHT UPON THE EYE, WITH A NOTE ON INCLUSION BODIES. W. S. DUKE-ELDER and P. M. DUKE-ELDER, Brit. J. Ophth. **13**:1 (Jan.) 1929.

A brief review of the literature is given, and the technic of the experiments carried out on rabbits is explained. The author gives the following conclusions: The clinical and histologic appearances of the abiotic reaction to light as seen in experimentally irradiated animals are described in the cornea, the conjunctiva, the iris, the lens and the retina. The changes observed in all these tissues are the same in kind, although varying in degree. The most interesting and characteristic of these changes is an oxyphil degeneration affecting particularly the nuclear chromatin, which may progress to the formation of acidophil granules or of granular or homogeneous nuclear inclusions. Originally intranuclear, these may be extruded into the cytoplasm with disintegration of the nuclei, a process which may culminate in death and disintegration of the cell. The reaction is characterized by an intense vascular engorgement, in places where it is possible, and is followed by rapid regeneration and resolution in which the absence of karyokinetic activity is notable.

The nature of the general abiotic reaction of living tissue is discussed, and it is pointed out that its basis is a photochemical denaturation affecting the proteins of the cells.

With regard to the cornea, the therapeutic effect of ultraviolet light in inflammatory, degenerative and ulcerative conditions is discussed.

With regard to the lens, two separate effects are demonstrated—the first, markedly evident histologically, affecting the capsule and the subcapsular epithelium, and the second, less histologically evident, affecting the lens substance. The significance of both of these in the pathogenesis of cataract is dealt with. It is concluded that, in common with other regions of the energy-spectrum, ultraviolet radiations cannot be exonerated from a share in the etiology of this condition. The subcapsular epithelial "wall" is described, but although several relevant influences are dealt with, no satisfactory explanation of its occurrence seems forthcoming; a similar appearance is seen in the corneal epithelium.

Definite abiotic changes are described in the retina, mainly affecting the ganglion cells and the inner nuclear layer. These consist essentially of a chromatolysis and an acidophil tendency. The significance of these changes is discussed, and the conclusion is suggested that they are rather of the nature of a pathologic intensification of physiologic processes of vision than a direct abiotic response, although the occurrence of the latter in a specially sensitized tissue is not altogether impossible.

An analogy is suggested between the nuclear appearances of abiotically traumatized tissue and the inclusion bodies described as occurring in the lesions caused by the herpetic and other viruses, and possibly also in trachoma. The analogy tends to support the opinion that these appearances are degenerative in nature and nonspecific in origin.

W. ZENTMAYER.

THE BEHAVIOR OF THE RETICULO-ENDOTHELIAL SYSTEM IN EXPERIMENTAL OCULAR DISEASES. F. SCULLICA, Ann di ott. **57**:15 (Jan.) 1929.

Modern conceptions of this system of connective tissue cells, its function in defensive tissue reactions and its distribution in the eye are reviewed. The characteristic cells which stain with lithium-carmine given intravenously are found in every tissue of the normal eye except the retina and choroid. The author produced lesions in the eyes of rabbits by keratotomy, discission, injection of iodine in the anterior chamber and prolapse of the iris, following which the animals were given intravenous injections of 4 per cent lithium-carmine for from three to eight days.

In linear wounds of the cornea, usually no cells of the reticulo-endothelial system (histiocytes) are found in the scar. After cauterization of the cornea, numerous histiocytes from the episcleral tissues and new formed vessels are found in the inflammatory tissue and resulting cicatrix. In penetrating wounds with prolapse of the iris, numerous histiocytes from the iris occur in the scar. These are most numerous in the early stages of repair, disappearing from the later scars. Lesions of the choroid and ciliary body show numerous histiocytes, while those of the retina show them only in the external layers, which they reach from the choroid.

S. GIFFORD.

Conjunctiva

DISEASE OF THE CONJUNCTIVA IN ERYTHEMA NODOSUM. A. VON RÖTTH, Ztschr. f. Augenh. **4**:322 (Nov.) 1928.

Cases of iritis and iridocyclitis, complicating erythema nodosum, were reported previously. In this article Rötth describes four cases of unusual complication involving the conjunctiva. The condition resembled the nodular type of conjunctival disorder found in exudative erythema multiforme in which nodules the size of a lentil develop in that part of the bulbar conjunctiva exposed in the cleft of the lid. In his cases they occurred on either side of the cornea, though usually toward the nose. The surrounding tissue was injected. These nodules involved the subconjunctival tissues, and probably also the episclera. They usually disappeared with the erythema nodosum in a few days. The prognosis was good. There was no pain. No treatment was needed. He regards this clinical picture as typical of erythema nodosum as well as erythema multiforme, except that the nodules, like the skin lesions, lie deeper in the tissues. He distinguishes this disturbance from tuberculous episcleritis by the position of the nodules, the absence of pain and photophobia and the lack of the violet red color of episcleritis. Lacrimation, moreover, is negligible.

S. J. BEACH.

Glaucoma

GLAUCOMA COMPENSATED BY MIOTICS. D. BASSO, Ann. di ott. **57**:11 (Jan.) 1929.

The author takes up the question whether miotics are capable of curing glaucoma in some cases, or whether, as is claimed by some surgeons, they are actually harmful by causing loss of time and making the prognosis for a later operation less good. Opinions on both sides are quoted. The author saw two early cases in which, after pilocarpine was used for six months, the anterior chamber regained a normal depth and the eyes could be considered normal after four and six years, respectively.

In four other cases, although vision and fields remained good, the chamber was shallow and the iris atrophic. The tension remained slightly above normal,

but apparently these eyes had adapted themselves to this higher tension. While the author believes that operation in the early stages offers the surest prospect of cure, the fact that in some cases normal conditions can be restored by the use of miotics should be recognized.

S. GIFFORD.

Retina; Optic Nerve

CURATIVE AND PREVENTIVE TREATMENT OF DETACHMENT OF THE RETINA. BETTREMIEUX, Ann. d'ocul. **165**:914 (Dec.) 1928.

The theories relative to the treatment for detachment of the retina are quite different. One, sponsored by Boucheron, favors operating within the first six days of the onset of this condition, while another, practiced by Grossman, does not advocate operation until all other modes of treatment, including medical and mechanical, have failed. Hirschberg keeps his patients in bed two and one-half months before attempting an operation, to determine whether the retina will return to its normal position during that period, while Darier prescribes absolute rest with the patient lying on his back, with a slightly compressive bandage and subconjunctival injections.

The author has thought for a long time that the first step in retinal detachment should be a nonperforating pericorneal sclerectomy. This treatment may be opposed by some on the grounds that sclerectomy is performed in cases of hypertension, while in detachment there is hypotension. However, together with Boucheron and others, Bettremieux has shown that in the beginning of a detachment of the retina, a slight rise of tension is present.

Another reason advanced for operative intervention is that the etiologic factor in detachment of the retina is frequently gout or rheumatism. Patients with these conditions often make progress when poor immobility is enforced. The author has seen patients with choroiditis, which undoubtedly at times causes detachment, improve under treatment by sclerectomy when medical treatment has failed. He thinks that nonperforating sclerectomy should be considered as a preventive in cases of choroiditis to ward off a detachment of the retina.

A case is presented in a man, aged 79, with choroiditis and detachment. Medical treatment had been tried without success. A nonperforating sclerectomy was performed and the detachment subsided.

H. W. SCARLETT.

RETINAL HEMORRHAGES IN HYPERTONIA AND ARTERIOSCLEROSIS. I. LANGE and F. LANGE, Klin. Wchnschr. **7**:2286, 1928; abstr., J. A. M. A. **92**:690 (Feb. 23) 1929.

The Langes examined sixty patients with retinal hemorrhages. In fifty-seven, they observed high blood pressure. Of this number, forty-two also showed symptoms of arteriosclerosis. For purposes of control, the authors examined some patients with arteriosclerosis without other complications, but never observed retinal hemorrhages. They therefore conclude that retinal hemorrhages usually indicate high blood pressure.

W. ZENTMAYER.

Neurology

FUNCTIONAL DIPLOPIA IN A SCHOOL BOY. A. M. MACGILLIVRAY, Brit. J. Ophth. **12**:588 (Nov.) 1928.

A healthy, highly intelligent boy, aged 8 years, had periodic attacks of double vision for six months. In reading, the patient saw two words instead of one, each word standing clearly alongside of the other without overlapping. When

reading from test charts he read each letter twice, with either eye separately or with both eyes. The vision in the right eye was 6/6 and in the left eye, 6/12. In all other respects, the eyes functioned normally and revealed no abnormality. The refraction was a low grade hyperopic astigmatism. Malingering was eliminated. No treatment was given. The child was assured that the trouble would disappear, and it was advised that no allusion be made to the double vision in his presence. Double vision had disappeared on examination six weeks later and had not recurred one year later. The vision was then 6/5. The author considers the condition purely functional.

W. ZENTMAYER.

OCULAR TROUBLES IN CERTAIN CASES OF TUMORS OF THE ANTERIOR FLOOR OF THE CRANIUM; MENINGIOMAS OF THE CRIBRIFORM PLATE. M. J. CHAILLOUS, Ann. d'ocul. **165**:881 (Dec.) 1928.

Meningiomas or endotheliomas of the dura are tumors seen along the entire cerebrospinal axis, and occur so frequently in the brain that Cushing said that of 1,398 intracranial tumors, 12 per cent were of this type. These tumors begin slowly and frequently attain astounding proportions before either subjective or objective symptoms appear. At times they are invaded by osseous projections, which make the complete removal of the mass difficult. However, to prevent a recurrence, it is necessary entirely to remove the invaded tissue. Frequently, recurrences take place. In one case quoted from Cushing's series there were eleven, and in another five, recurrences. In his atlas dated 1835, Cruveillier gave an excellent illustration of a meningioma of the cribriform plate of the ethmoid. In 1911, Cushing examined a patient at post mortem, who had complained of blindness and mental disturbance. Again in 1921, he saw a similar case, both of these patients had succumbed after a decompression.

Kennedy, in 1911, was the first to draw attention to a syndrome observed in lesions localized in the anterior part of the cranium. It was characterized by the unilateral loss of smell and vision, with primary optic atrophy of the same side and papillary edema of the opposite side due to intracranial compression. There was also a mental disturbance. Two other cases were reported by Siewers in 1921, with similar symptoms in addition to a large central scotoma in one case.

A patient operated on in 1922 by Cushing had a meningioma weighing 60 Gm. which was removed in three sessions. The preoperative diagnoses in this instance had been aneurysm of the internal carotid, ethmoiditis, frontal tumor and pituitary tumor. An intranasal operation had been performed, and roentgen irradiation to the pituitary region had been given.

The author reports the history of a patient, operated on by de Martel, in whom 80 Gm. of a tumor was removed from the anterior portion of the cranium. On account of a profuse hemorrhage, it was impossible to complete the operation.

He groups the cases under two types: (1) those showing atrophy of one optic nerve and edema of the other; (2) those showing a retrobulbar neuritis, in which the diminution of vision is not accompanied by any objective sign for a certain length of time, and then a primary optic atrophy develops. The first type is not so difficult to diagnose. The second, however, may be mistaken for toxic and infectious retrobulbar neuritis as well as for that due to multiple sclerosis.

In summarizing, the author says that one should think of meningioma if the following signs are present: (1) diminution of vision; (2) retrobulbar neuritis; (3) unilateral optic atrophy, with beginning edema of the other disk; (4) central scotoma; (5) exophthalmos on the side of the lowered vision, and (6) mental disturbance.

H. W. SCARLETT.

Ocular Muscles

REFLEX IRIDOPLEGIA (ARGYLL ROBERTSON PUPIL) AND PTOSIS AS A SURFACE SYMPTOM IN SYPHILITIC BASILAR CEREBRAL CONDITIONS. I. SVEN, Acta ophth. **6**:11, 1928.

From a review of the literature, Sven concludes that reflex iridoplegia is found most frequently in syphilitic diseases of the brain tissue. The pupillary disturbance in this disease pursues a characteristic course. At first, the reaction of the pupil is retarded and sluggish to light. The normal rounded circumference becomes irregular, and the sphincter shows peristaltic and wormlike movements when stimulated. Synchronously with this reaction the pupil contracts, and when the iridoplegia is complete a definite miosis develops. Anisocoria is usually present in the early stages. Miosis is usually bilateral. This pathologic phenomenon has been attributed by several investigators to meningitic and vascular changes in the nerve tissue of the optic tract and to nuclear degenerations, but Sven is not in accord with their deductions.

From a careful study of the optic tract in man and animal, he concludes that the light reflex pathway is located in the superficial layers of the optic system in the midbrain. He notes that the nerves innervating the levator palpebral and superior rectus muscle are also in the superficial layers of the oculomotor nerve. A histologic examination of brain tissue removed from a tabetic subject also showed that the pupillary motor pathway and the nerves of the levator palpebral and superior rectus muscles are in the superficial strata of their respective tracts. The pupillary reactions observed in metasyphilitic diseases led him to believe that the pathologic lesion is probably in the midbrain and is due to a subpial degeneration. He therefore concludes that the iridoplegic phenomenon (Argyll Robertson) may be regarded as an ordinary metasyphilitic meningitic symptom and that the isolated ptosis may likewise be considered as a sign of disturbance of the superficial layers of the oculomotor nerve.

A. M. YUDKIN.

Orbit, Eyeball and Accessory Sinuses

BILATERAL PULSATING EXOPHTHALMOS. M. ESTEBAN, Arch. de oftal. hispano-am. **28**:331 (July) 1928.

Almost immediately after a crash in an airplane in 1922, a military aviator developed a bilateral exophthalmos. This was accompanied by an intracranial bruit which for a time prevented sleep. After two years, paralysis of the external rectus of the left eye occurred. The vision gradually failed in the right eye. When examined by the author, both eyes were almost extruded from the orbit and were deviated inward from paralysis of the external recti. The conjunctiva and episcleral vessels were enormously dilated. There was a visible pulsation of both eyes, isochronous with the arterial pulse and accompanied by a thrill. A loud blowing murmur was heard over the eyeballs and the periorbital region. Compression of the right carotid had no influence on this symptom, but compression of the left carotid caused it to cease on both sides. The tension of the right eye was increased, the cornea infiltrated and the pupil dilated and immobile. The vitreous was hazy. No details of the fundus could be obtained. The eye was blind. The tension of the left eye was normal; the retinal arteries were contracted; the veins were dilated and varicose, and pulsated; the choroidal vessels were dilated. The vision of this eye was 8/10. The visual field was normal. The bruit was likened to escaping steam. It was increased by compression of the right carotid, which caused a full feeling in the head. Compression of the left carotid fully controlled the bruit, as it did also the trigeminal neuralgia.

The lesion is believed to be a rupture of the left carotid within the left cavernous sinus, produced probably by a spicule of bone. The author explains the various phenomena produced by such a lesion and also the exacerbation of the symptoms resulting from compression of the right carotid. He attributes the painful attacks and the loss of vision in the right eye to glaucoma from venous congestion similar to that which results from ligature of the varicose veins.

Ligature of the left carotid resulted in a complete disappearance of the exophthalmos and other external symptoms and a pronounced reduction of all the intra-ocular congestive symptoms.

C. E. FINLAY.

Tumors

A CASE OF MALIGNANT LYMPHOMA. M. GOLDENBURG, Am. J. Ophth. **12**:116 (Feb.) 1929.

A woman, aged 56, first seen in September, 1926, complained of a thickening of the left lower lid which had been present since the previous spring and which was at times itchy. The left lower lid bulged slightly forward, and retraction disclosed two rolls of a grayish-pink tissue extending from the inner to the outer canthus, occupying the entire inferior culdesac. It was hard, well circumscribed and extended some distance into the orbit. The overlying conjunctiva was movable. The growth was removed under local anesthesia, and the laboratory made a diagnosis of malignant lymphoma. About a week after operation, diplopia developed and persisted. Radium was used, and there has been no recurrence.

W. S. REESE.

Operations

INTRACAPSULAR EXTRACTION WITHOUT IRIDECTOMY. H. M. MORTON, Am. J. Ophth. **12**:90 (Feb.) 1929.

The author gives a brief historical sketch of intracapsular extractions. He believes that simple intracapsular extraction helps prevent loss of vitreous, and he has done twenty-five of these operations, eighteen of which resulted in round pupils. In seven there were varying degrees of incarceration of the iris, arising from prolapse of the vitreous. He describes the preoperative preparation. One hour before operation he instils a drop of 1 per cent atropine, and if the pupil does not dilate, iridectomy is done. Complete local anesthesia is important. This is obtained by using 2 drops of an 8 per cent solution of cocaine to which has been added a few drops of epinephrine hydrochloride; this is instilled into the eyes four times at five minute intervals. He stresses training of the patient and lid control, and uses a bar type speculum without a spring. The orbicularis is not paralyzed, and meddling is strongly condemned. The bandage is kept on for six or eight days.

W. S. REESE.

CUNEIFORM IMPLANTATION OF ORAL MUCOSA INTO THE INTERMARGINAL SPACE IN TRICHIASIS OPERATION. A. KREIKER, Klin. Monatsbl. f. Augenh. **80**:386 (March) 1928.

Kreiker resects from the lower lip a piece of mucous lining with submucous fat and granular tissue; this is implanted in an intermarginal section of from about 2 to 3 mm. depth along the anterior margin and surface of the tarsus; the flap is retained readily and is kept in place by fibrinous adhesions. Sutures are unnecessary. Permanent results are obtained.

K. L. STOLL.

Therapeutics

SUBCONJUNCTIVAL INJECTIONS OF ATROPINE AND ADRENALIN IN IRIDOCYCLITIS. A. L. BROWN, Am. J. Ophth. **12**:118 (Feb.) 1929.

The author uses a subconjunctival injection of 4 minims (0.24 cc.) of epinephrine hydrochloride, and 1 minim (0.06 cc.) of 2 per cent atropine in cases in which there is no response to instillations. These injections are made as near the limbus as possible, at the point of adhesions of the iris to the lens.

W. S. REESE.

EFFECTS OF NONSPECIFIC PROTEIN THERAPY ON OCULAR CHANGES IN MULTIPLE SCLEROSIS. G. E. HALL and R. C. GAMBLE, J. A. M. A. **92**:297 (Jan. 26) 1929.

In this preliminary report, Gamble makes a plea for diagnosis of multiple sclerosis early in its course. Attention is called to the need of conservatism in recommending operation on the posterior sinuses unless a definite pathologic condition can be clinically established, notwithstanding the many opinions to the contrary. On the generally accepted belief that multiple sclerosis is due to an infectious agent, the patients were treated with a nonspecific protein in the form of typhoid and paratyphoid vaccines in doses sufficiently large, when given intravenously, to produce a chill followed by a moderate rise in temperature, similar to that employed in the treatment for paresis, except that the temperature was lower, ranging from 100 to 102 F. in most instances. The vaccines were given every other day, as a rule, until twelve doses had been given. Some of the patients have received as many as three series of twelve treatments, a month or six weeks being allowed to intervene between each two series. Twenty-five patients in all have been treated. Ocular disturbances were found in about 50 per cent of the cases. Eleven cases in which treatment was given are reported in more or less detail. No definite conclusion can be formed as to the effect of this treatment on the visual changes until further work is recorded, but the authors believe that it will prove of real worth if it can be instituted before the cardinal symptoms have developed. General physical improvement is established.

W. ZENTMAYER.

THE USE OF EPHEDRINE IN OPHTHALMOLOGY. PAUL MUELLER, Klin. Monatsbl. f. Augenh. **80**:669 (May) 1928.

Mueller reports two and one-half years' experience with ephedrine hydrochloride in the form of subconjunctival injections in chronic glaucoma, in iridocyclitis to break the posterior synechiae and in perforations of the cornea. He finds that a 2 per cent solution surpasses the mydriatic action of epinephrine hydrochloride in children and in older people; the action is quicker and is sufficient for diagnosis, lasting from three to twelve hours, and can be offset by pilocarpine. No attack of glaucoma was observed, although the ephedrine was used in some cases of chronic glaucoma as a mydriatic.

K. L. STOLL.

Society Transactions

EDITED BY DR. GEORGE S. DERBY

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

Regular Meeting, Dec. 18, 1928

S. J. BEACH, M.D., *Chairman*

ENCAPSULATED INTRA-OCULAR FOREIGN BODY. DR. J. HERBERT WAITE, Boston.

A foreign body was observed to become encapsulated in a patient observed for two years. During this time the ocular media remained clear. Siderosis did not develop, probably because the fragment was a piece of alloy steel which resisted the corrosive action of the body fluids.

The slow decrease in visual acuity from 20/20 to counting fingers at a distance of several feet was probably the result of traction on the macula. Repeated attempts to dislodge the foreign body with a giant magnet were unsuccessful. X-rays now show a shadow of the same size and in exactly the same position as that observed when the patient was first examined. Until about four weeks before presentation an object with acute angles and a metallic luster was visible above the nerve head. At this site, nothing is visible at present but a mound of white tissue.

CORECTOPIA. DR. PAUL CHANDLER, Boston.

A boy, aged 8 years, showed eccentric pupils placed temporally in each eye. A defect of the iris stroma in the upper outer quadrant, disclosed the black pigmentary epithelium. The vision was 20/20 in each eye. No other abnormalities were found.

MELANOMA OF THE IRIS. DR. PAUL CHANDLER, Boston.

On the right iris of a patient, aged 30, there was a flat pigmented spot, which had not enlarged during ten years.

MELANOSARCOMA OF THE IRIS. DR. BENAMIN SACHS, Boston.

A man, aged 24, had at the nasal portion of the left iris, a pigmented mass which he thought had been increasing in size during the past few months. Examination by slit-lamp showed that the tumor protruded from the surface of the iris, and had a nodular surface and a deep brownish color, with pigmented strands running into the stroma of the iris, and that it was 3 mm. wide, 5 mm. long and 1.5 mm. deep. The tumor was out of sight in the angle of the anterior chamber, and did not display the slightest excursion with pupillary movements. The pupillary area of the iris was not involved. The ocular media and fundus seemed normal as far as they were visible through the dilated pupil. The visual acuity was 20/20, and the ocular tension normal.

DISCUSSION

DR. G. S. DERBY, Boston: I should attempt to excise the tumor by iridectomy, in order to make a histologic diagnosis. If the condition was found to be malignant, the globe should be promptly enucleated.

Dr. Allen Greenwood, Boston: I consider iridectomy dangerous. In all likelihood, the tumor could not be removed completely. I feel, therefore, that it would be wiser to irradiate the eye, watch the tumor, and, if it increased in size, perform enucleation. In a similar case, after incomplete removal the tumor rapidly filled the eye and extended into the lids. Fortunately, in this case, removal of the eye and application of radium prevented further metastasis and forestalled a fatal termination of the condition.

A Case for Diagnosis. Dr. Edwin B. Dunphy and Dr. Theodore Terry, Boston.

In the case presented, the clinical diagnosis was miliary tuberculosis with retrobulbar neuritis. At autopsy, however, carcinoma was found in the chest, with multiple metastases to the brain, meninges and optic nerves. This case will be reported fully in one of the current ophthalmologic journals.

Sporotrichal Infection of the Upper Lid. Dr. Howard F. Hill, Waterville, Me.

A case of sporotrichal infection of the upper lid was observed for three years. Dr. Verhoeff succeeded in growing sporothrix from excised tissue.

Tumor of the Suprarenal Gland. Dr. Howard F. Hill, Waterville, Me.

A case of tumor of the suprarenal gland was reported, with metastasis to the orbit as verified by histologic evidence.

DISCUSSION

Dr. Greenwood: I saw a similar case in a boy, aged 3 years. There were neuroblastomas in each orbit, and a tumor developed subsequently over one kidney.

Sugar Tolerance Tests in Cataract. Dr. E. R. Blaisdell, Portland, Me.

In a study of 100 consecutive cases of cataract at the Maine Eye and Ear Infirmary, Dr. Blaisdell applied the sugar tolerance test to all patients whose condition was not diagnosed clinically as diabetes. The test consisted of the administration of 100 Gm. of dextrose by mouth, and the testing of the blood and urine for sugar after two hours. A considerable number of the patients were found to handle sugar poorly. Attention was paid also to measurements of the blood pressure and to the cardiovascular system of each patient.

DISCUSSION

Dr. Derby: This study is of great interest. In my opinion, if the diabetes is under control, the patient recovers from an operation for cataract just as well as any ordinary patient does. I believe that hypertension is of more serious concern. In my service I have established a rule that patients will be submitted to an operation which opens the globe of the eye only when the diastolic pressure is no higher than 100 mm. of mercury. This rule has been instituted as a result of postoperative intra-ocular hemorrhage which occurred in several patients with a high preoperative diastolic blood pressure.

Dr. J. H. Waite: I believe that the genesis of cataractous changes calls for a much more extended investigation of the exchanges which take place across membranes between the blood, the ocular fluids and the lens cells and fibers.

Dr. S. J. Beach, Portland, Me.: An increase in the amount of blood sugar in certain cases does not seem to have a great deal of influence on the progress

of the cataract. Repeated surges of sugar into the blood stream of those patients who handle sugar poorly may influence the promotion of cataract.

DR. BLAISDELL: The patients with hypertension were placed on a salt-free diet before the operation. Blood pressure could thus be reduced, minimizing the possibility of a postoperative hemorrhage.

DR. GREENWOOD: I have found the salt-free diet helpful as a preparation for operation in cases of hypertension.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

THOMAS H. JOHNSON, M.D., *Secretary*

Dec. 17, 1928

BERNARD SAMUELS, M.D., *Chairman*

A CASE OF INTRACRANIAL CYST WITH DOUBLE CHOKED DISK IN A CHILD; OPERATION AND RECOVERY. DR. RAYMOND C. DODD.

The patient was first seen in 1922, on account of cerebral symptoms. She was then 6 years old. At that time there were no ocular abnormalities except for some tortuosity of the retinal veins. In the course of several months symptoms became intensified, and papilledema appeared and reached a grade of from 3 to 4 diopters, accompanied by retinal hemorrhages. Drs. Tilney and Elsberg, in consultation, agreed that decompression with exploration should be promptly done. However, a fall from a porch hammock at this juncture brought about a subsidence of all symptoms and a gradual return of the optic disks to normal.

After complete freedom from symptoms for over one year, in the fall of 1924, the patient began to have headache which steadily grew worse, and was then accompanied by vomiting. In May, 1925, the vision in each eye was 20/15, and there was papilledema with paresis of the left external rectus. In June, the papilledema measured 1.5 diopters in each eye with normal acuity as before. At this time, horizontal nystagmus was noted when the patient looked toward the sides, especially toward the right, and there were increasing headache, weakness of the right leg and numbness of the right side of the face. In July, there was partial paralysis of the right forearm and hand lasting for about twenty minutes. At this time the vision was still 20/15, the papilledema 2 diopters in each eye, and there was homonymous red glass diplopia increasing to the left. On July 23, a definite small hemorrhage was noted along the nasal margin of the left disk. Three days later, a partial paralysis of both forearms and hands developed, which affected the right first, and lasted an hour or so. On August 2, the vision remained 20/15 in each eye, homonymous red glass diplopia increasing to the left, nystagmus and papilledema of 2.5 diopters accompanied by two flame-shaped hemorrhages on the right disk and one on the left disk.

On August 11, the patient was operated on in Boston by Dr. Harvey Cushing, whose notes follow:

Name: June Johnson. Surgical number = 24519.

Summary of Positive Findings:

Subjective: 1. Projectile vomiting, intermittently, from 1917 until 1922.
2. Slight unsteadiness in gait with attacks of vomiting over same period of time.

3. Bilateral choked disk at the same time.
4. History of complete relief from symptoms following a fall in August, 1922, until two months ago.
5. Now a recurrence of attacks of projectile vomiting, unsteady gait, headache and vertigo, and choked disk.
6. History of numbness of the right upper lip on one occasion.
7. Slight blurring of vision recently without diplopia.

Objective:
1. Enlarged head, separated sutures, cracked pot sound.
2. Bilateral choked disk, 2-3 diopters, with old scarring in the disk.
3. Nystagmus, fairly rapid, sustained, on looking to right and left.
4. Very marked hypertonia.
5. Ataxia of the left arm, moderate in extent, on carrying out certain tests.
6. Romberg test positive, gait slightly unsteady, tendency to stagger toward right.
7. Moderate degree of hypermetria, lower extremities, which patient can control.
8. Very sluggish superficial and deep reflexes.

Special Note of Aug. 11, 1925:

This little girl had a definite cerebellar syndrome, but with a curious long (4 to 5 years) antecedent history with very marked remission in symptoms, so that it is little wonder that she had her appendix removed and other things done under the belief that her troubles must certainly have been gastro-intestinal. It was a natural assumption that we would probably find a benign glioma (astrocytoma) probably with cyst. She had however quite the reverse of the usual clinical picture of a midline tumor; in other words, she showed quite the reverse of the usual picture.

There was marked nystagmus and extremely little static disability. Indeed, during all these years, there have been times when she has been so free from any static disability that she had danced and skated. Her finger to thumb tests, and her skin tests were performed almost normally yesterday, although she was having a very bad attack.

Operative Note of Aug. 11, 1925:

Suboccipital exploration. Anaesthesia — ether. Removal of atlas. Exploration of a large, median cyst with marked cerebral herniation. Evacuation of cyst, and fixation with formaldehyde. Fragmentary removal of tumor over fourth ventricle.

This operation, I regret to say, did not go very smoothly. The child did not take her anaesthetic particularly well at first. There were some slips in the technique, and what should have proved to be a simple cerebellar exposure was somewhat complicated in consequence.

There was a good deal of bleeding in the approach, owing to the marked vascular channels, and it was not until I had punctured the ventricle that bleeding was more or less controlled.

On exposing the bone from over the cerebellum, I began to have doubts as to whether there would be a tumor at all, for there was no bulging, and the bone was thicker than I would have expected in a child. Indeed, there was an unusual prominence of muscular formation, such as one often sees in an adult.

After incising the dura, there presented almost immediately a marked bulging of the uvula, which was whitish in color, and through the arachnoid looked as if there might be a cholesteatoma. Moreover, there was very marked herniation so that I immediately removed the posterior arch of the atlas and carried the incision down to the axis.

It was quite evident that there was a big median tumor, probably cystic, and on making a median incision, as shown in the accompanying sketch, I came down immediately on the bulging wall of a large midline cyst. The cyst was punctured, and about 75 cc. of dark fluid was evacuated. The cyst proved to be absolutely mid-line, and at the bottom, overlying the fourth ventricle, was seen the surface of a broad tumor nodule, which had a curious flecked appearance, owing to the irregularities on its surface, such as one sees in an ependymitis.

I immediately started to fix the cyst walls, first with 10 per cent, and then with 50 per cent formaldehyde.

The tumor nodule proved to be extremely tough, and I think I might very well have gone ahead with an attempted extirpation, and possibly was very foolish not to have done so at this session. However, I removed a small snip from the surface of the tumor for histologic verification, although I have no doubt of its being an astrocytoma. It proved to be somewhat more vascular than I had anticipated, so I desisted from attempting the complete enucleation, as the operation was already somewhat prolonged and things did not seem to be going very well.

The wound was then closed securely in layers after filling the cavity with salt solution.

I may say in view of possible future surgical measures in this case, that the lower margins of the dura were excised over the fourth ventricle, and down to the cord, were closed, and though I brought the upper edge of this closure to meet the lower edge of the tag of dura over the torcule, I subsequently severed this suture, for I thought it might complicate future explorations, should any be called for, if this dense median zone of dura should be left in position directly over the lesion. It, moreover, might form such an extrusion of the cyst, should it refill, as would be desired for the sake of decompression.

DR. CUSHING.

Post-Operative Note:

June Johnson improved continuously after the operation, and on discharge from the hospital on September 2, she was having no headache, nausea, or vomiting. She still had a moderate amount of hypotonia, and her Romberg test was still slightly positive. Her disks were flat, with a moderate amount of residual secondary atrophy, but no impairment of her visual acuity. A few nystagmoid twitchings remained. There was some ataxia of both arms in the finger to nose test, but she could use her hands very well in doing the ordinary things such as getting dressed, tying her shoe strings, etc.

On her return home, Dr. Dodd found a visual acuity of 20/15, residual tortuosity of the retinal veins, scar tissue on the nerve heads and absence of diplopia or nystagmus. Subsequently she has grown somewhat myopic, but otherwise her eyes are normal. Her general condition is excellent, and she enters into all the activities of a normal child of 12 years of age.

The distinctive features of this case are:

1. Absence of certain characteristics of midline tumor.
2. Cessation of symptoms following traumatic rupture of the cyst.
3. Interval of two years, entirely free from symptoms.
4. Return of symptoms, followed by exploration, by demonstration of midline tumor, and by three years of freedom from symptoms.

A Case of Circumcorneal Papilloma. Dr. William Brown Doherty.

This article will be published in full in a later issue of the Archives.

A Case of Zonular Keratitis. Dr. Raymond C. Dodd.

J. F. C., a man, aged 54, was first seen in 1923, when vision in each eye was 20/15 with plus 0.5 spheres.

On Jan. 31, 1927, the right eye was reddened, and the vision in it was blurred. A mild iritis was present, for which atrophine and acetyl salicytic acid were ordered. Within a few days, there appeared in the cornea punctate dots which seemed to be in the stroma rather than on Descemet's membrane. At this time the vision under atropine was 20/20 with plus 1.00 sphere in the right eye. There were some vitreous opacities but the iris was fully dilated, and without synechia. During the next six weeks, the cornea cleared, and the vision returned to 20/15.

Several weeks later, opacities appeared in the vitreous of the left eye, with visual acuity cut to 20/20. A roentgenogram of the teeth revealed two abscessed roots, and these teeth were removed. In spite of this, vision in the left eye steadily dropped to 20/40. Soon thereafter, iridocyclitis returned to the right eye. Both pupils readily dilated without synechia. In May, 1927, the vision was 20/30 in each eye, and the left lens showed striate subcapsular opacities of moderate degree.

The chemical examination of the blood showed a high percentage of urea and creatinine, but otherwise the results were normal.

The patient's physician had been treating him for chronic nephritis. The patient had used alcohol for a long time, and he was repeatedly warned to discontinue its use.

The patient was not seen for nearly a year, not until July, 1928, at which time the vision in the right eye with plus 1.50 sphere was 20/20— and the left eye with plus 2.00 sphere was 20/30. During this interval he had been severely ill from nephritis. At this time, it was noted that a ribbon opacity ran horizontally across each cornea, beneath the epithelium. No atropine had been used in either eye for ten months, and now there appeared firm posterior synechia, which 2 per cent atropine failed to break. The corneae were insensitive to cotton wisps.

In December, 1928, the vision with lenses in the right eye was 20/30, and in the left eye 20/200. At this time tension with the McLean tonometer registered 22 right and 27 left. The Wassermann reaction of the blood was negative, and the urine showed traces of albumin.

Dr. Dodd's diagnosis was zonular keratitis, and he believes that the case is unusual since it presented no glaucoma, and no degeneration of the globe, such as is often found in eyes with zonular keratitis. The corneae in this patient seemed smooth, and the slit-lamp revealed opacities in and below Bowman's membrane.

A Case of Corneal Coloration with Hepatolenticular Degeneration. Dr. Daniel L. Poe.

A youth, aged 20, presented in each eye an irregular circle of pigment near the limbus, located entirely in Descemet's membrane by slit-lamp determination and sparing the substantia propria entirely. The pigment band was approximately from 2.5 to 3 mm. in width, and its color was a dirty green-brown-yellow. The location of the pigment, combined with generalized tremor, dysarthria, muscular hypertonicity even rigidity and spasmodic contractions led us to think of the syndrome hepatolenticular degeneration (Wilson's disease).

Two years before, the patient first noticed that his hands were not as steady as they should be. Prior to this he had always been in excellent health. In the

course of time, the tremor became so much worse that he had to discontinue his work as general laborer, and he presented himself for examination and treatment.

There was at this time coarse tremor in the arms and hands, aggravated by intentional movements, scanning speech, continuously open mouth, masklike expression, hypertonicity and rigidity of muscles and contractures in the right arm and leg which made walking difficult. In attempting to stand on a small base, he fell stiffly backward. His pyramidal tract reflexes were normal.

This disease was first classically described by Kinnier Wilson, and is therefore frequently referred to as Wilson's disease. Wilson, however, failed to mention corneal pigmentation in his papers. All patients who clinically presented the foregoing symptoms, and who came to autopsy, have invariably shown a bilateral degeneration of the lenticular nucleus, and also cirrhosis of the liver. We are informed repeatedly that cirrhosis of the liver rarely, if ever, during the life of the patient gives rise to symptoms.

In 1903, Fleischer described a corneal pigmentation in a patient who presented this symptom complex, and he localized the pigment to Descemet's membrane only, and found that it gave no iron reaction, and that it was soluble in ammonium sulphide. Since then, the so-called Fleischer's ring has been demonstrated in a number of cases of hepatolenticular degeneration, and it has come to be looked on as an integral part of this syndrome.

Dr. Poe advanced certain interesting speculations concerning the manner and mechanism of the corneal pigmentation. In this patient, there was evidence of an increased icterus index and van den Bergh reaction in the blood, and of increased urobilin in the urine. The skin of the patient suggested icterus. Citing the evidence of Salzmann that the peripheral Descemet's membrane is bathed anteriorly and posteriorly in aqueous, and that Descemet's membrane has different staining reactions than corneal stroma, Poe thinks it is conceivable that the increased biliary products of the blood stream have access through the aqueous to the most accessible portions of Descemet's membrane. This would account for the fact that Fleischer's ring of pigment practically always encircles the peripheral portions of Descemet's membrane.

DISCUSSION

Dr. Ernst Waldstein: About twenty years ago I saw with Dr. Samuels, a typical case of "pseudosclerosis multiplex," which has later come to be known as Wilson's disease. A man, aged 30, from the lower strata of society, addicted to the use of alcohol, presented a characteristic Fleischer ring, which could not be studied in detail before the days of the slit-lamp. He raised two questions:

1. How does one discriminate between real sclerosis disseminata and Wilson's disease?

2. Why do the oxidation products of copper in intra-ocular copper foreign body lodge in Bowman's and in the lens capsule? Did the slit-lamp reveal any pigment in the lens capsule of Dr. Poe's case?

Dr. Daniel Poe: I recall a case from the literature in which there was hepatolenticular degeneration with Fleischer's ring, and Purtscher's pseudocataract. I could not find any abnormality in the lenses of the case here reported.

I feel that the differentiation between multiple sclerosis and hepatolenticular degeneration is not difficult. In true multiple sclerosis, there is degeneration in the pyramidal tract, with exaggerated reflexes, while in hepatolenticular degeneration, the lesions are extrapyramidal, and as a consequence the reflexes are not exaggerated.

A Case of Monocular Diplopia, Bilateral, the Result of Chronic Encephalitis. Dr. Daniel L. Poe.

A college girl, aged 20, purported to see double with either eye, while the other eye was completely excluded from the visual act. She averred that the true and false images were both clear with the right eye, and that they were both somewhat blurred with the left eye. When both eyes simultaneously took part in the visual act, she saw double, and not quadruple as one has a right to expect. Quadruple vision is brought about, however, by interposing a red or blue glass before one eye, when both eyes are being used.

At the age of 16 she was taken acutely ill, and admitted to a Brooklyn Hospital, where a diagnosis of encephalitis was made. Six months after this, she had completely regained her health, felt better than ever, and had gained about 20 pounds (9 Kg.) in weight. She resumed her studies at college. Eighteen months ago, she first noticed a slight trembling in her right arm and hand, which gradually became worse.

She felt a stiffness in her muscles generally, and gradually developed the condition that is presented here: masklike facies, staring eyes, stiffness of gait, scanning speech, peculiar posture, slow movement, coarse tremor and coarse nystagmus when she fixes either to right or left.

The double vision with one eye was first noticed about one week after the onset of the illness. It then disappeared, and did not reappear until four months ago, and it has remained with her ever since. The false image is said to be dimmer, about one-fifth smaller, and usually lower than the true image. Dr. Poe observed her for about three months, having her draw the images repeatedly as she saw them, and he submitted the records to the meeting. Furthermore, he had Dr. Minsky study the patient with red glass, with Maddox rod, and with certain prism tests, all of which seem to support the belief that monocular diplopia exists.

DISCUSSION

Dr. Ben Witt Key: I felt that the diplopia was due to her state of mind, and advised covering one eye for a week to eliminate the impression of binocular diplopia. I observed her for three weeks in the hospital in this manner. I felt that I could not get answers relative to monocular diplopia free from contradictions, and hence that I could not be sure that monocular diplopia existed. I wish to call attention to the fact that no reasonable neurologic explanation can be advanced to account for monocular diplopia, and, furthermore, that encephalitis may produce a cataleptic state with inhibition so affected that such a symptom as this might persist and thus appear to be real.

Dr. Sigmund Agatston: I wish to ask Dr. Poe whether encephalitis might give rise to a disturbance in the coordination of the impression which passes from each macula to each of the occipital lobes? I wonder if an additional macula might not have been developed since the attack of encephalitis.

Dr. Julius Wolff: Has the patient's accommodative power been tested, and was there an astigmatic refractive error?

Dr. Jacques Landesberg: A case of monocular diplopia in a child 8 years of age was reported by MacGillivray in the November issue of the *British Journal of Ophthalmology*. The school teacher had noticed that the child would copy twice any single figure placed on the blackboard. MacGillivray could find nothing except low amount of hyperopic astigmatism.

DR. THOMAS H. JOHNSON: I thought that the condition seemed one of hysteria, I cannot explain why the patient could overcome a 10 degree prism base in giving two images as with one eye alone. Ten degree base up or down before one eye of the patient, however, gives consistently four images, with correct designation of the displacement.

DR. LE GRAND HARDY: I suggest three possibilities:

1. Hysteria.
2. Double imagery due to variation of the refractive surfaces.
3. Nervous or psychic mechanism.

If the second is ruled out, there remains the diagnosis of hysteria or a bilateral double representation of macula somewhere between the retina and the brain. I have seen a squinting eye, when made straight, have monocular diplopia, possibly on account of having developed a false macula. I feel that the case reported might fall in this category.

DR. HENRY H. TYSON: Could the present case not best be explained by Parinaud's theory of cyclospasm, it being either of a regular or irregular type? Diplopia, triplopia or polyplopia may be the result, and I believe that this is a functional disturbance.

DR. DANIEL L. POE: I wonder if the nystagmus might have been a factor in the development of the monocular diplopia? I cannot subscribe to the belief that an additional macula had developed since the encephalitis. The postmortem evidence in encephalitis is to be found chiefly in the basal ganglions rather than the cortex, and I feel that physiologic dissociation is quite conceivable in such an instance. The patient here demonstrates other signs of basal ganglion disturbances, such as nystagmus and altered pupillary reactions, with constant dilation. It is possible that there may be a disturbance in the nucleus for accommodation, so that the lens is unevenly contracted. If this were true, one would expect more than two images.

None of the physicians who examined the patient has been able to find a refractive error, displaced lens, double pupil, double macula, or irregularities in the media.

DR. LEWIS WEBB CRIGLER: As the pupils of the patient were dilated and reacted sluggishly to light, I wish to ask whether tests were made both with dilated, and with contracted pupils?

DR. DANIEL L. POE: Dr. Reese had a patient whose monocular diplopia disappeared when the pupil was contracted. I hesitate to use miotics, but the diplopia in the case here reported persisted when the tests were made through pinhole disks.

RADIUM THERAPY IN DISEASES OF THE EYE AND ADNEXA. DR. G. ALLEN ROBINSON.

This article appears in full in this issue, p. 583.

THE NEW INTRACAPSULAR OPERATION FOR CATARACT EXTRACTION. DR. C. B. MEDING.

This article appears in full in this issue, p. 569.

ROYAL SOCIETY OF MEDICINE, SECTION ON OPHTHALMOLOGY

Regular Meeting, Jan. 11, 1929

CYRIL WALKER, M.D., *President, in the Chair*

CASE FOR DIAGNOSIS. MR. FOSTER MOORE.

The patient had a lens which was becoming partly opaque and was pushed to one side. He had keratitis punctata and what seemed to be a cyst, which was responsible for the displacement of the lens. There was no history of trauma, though one might have expected an accident to have been the cause. The presence of the keratitis punctata seemed to stamp the condition as inflammatory. It was a translucent growth. There appeared to be no intra-ocular foreign body. The tension of the eye was not raised.

DISCUSSION

MR. MAYOU: I had a somewhat similar case in a child with a cyst of the pigment epithelium of the iris.

MR. HUMPHREY NEAME: It is possible that the keratitis punctata may be due to lens matter. Several years ago, I reported, pathologically, a case of cyst of considerable size in a man who was thought to have a new growth of the choroid. On section of the eyeball afterward, however, the mass proved to be a cyst. It had been dark to transillumination because it contained blood, a possibility to be borne in mind.

ALBUMINURIC RETINITIS. MR. J. H. COOK.

The patient, a woman, considered herself in good health, and said that deterioration of vision dated only a fortnight before presentation. The case showed a sheathing of one of the vessels by exudate.

CYST OF THE ETHMOIDAL LABYRINTH. MISS MARGARET DOBSON.

An ex-service man, aged 30, had a cyst of the ethmoidal labyrinth, causing proptosis. In October, 1925, gradual and painless protrusion of the left eye became noticeable. The proptosis extended forward and downward. The tension of the eye was slightly increased. After sneezing, a slight quantity of brown fluid was discharged through the nostril, and dripped for half an hour. After it ceased, there was less protrusion of the eye and double vision had disappeared. On pressure between the eyeball and the inner orbital wall, a buckling could be felt. A roentgenogram showed that the ethmoid cells on the left side were distended.

CENTRAL CHOROIDITIS. ROSA FORD.

The man, who was first seen in 1920, was then 49 years of age. He had a small patch of central choroiditis in the left eye. Vision was 5/60. The Wassermann test being slightly positive, the man was referred to his physician for treatment. In 1923, Miss Ford saw him again, as he was complaining of the other eye; in it there was a small patch of choroiditis close to the fovea. Vision in this eye was 5/9. There was now a large area of choroidal atrophy. The blood showed a negative Wassermann reaction on two occasions; the cerebrospinal fluid also gave a negative reaction. Dental sepsis did not seem not to have anything to do with the condition, though the patient was given an autogenous vaccine

derived from septic stumps. Several physicians examined the patient, but failed to find anything wrong; and three nasal surgeons agreed that there was no nasal sepsis. Radiologic examination gave negative results. After resection of the septum in 1924, however, the vision improved, and the spread of the choroiditis was checked. Miss Ford at first had thought the condition to be retrobulbar neuritis. She asked for suggestions as to etiology, but the case was not discussed.

BILATERAL ARGYLL-ROBERTSON PUPIL AFTER A HEAD INJURY. MR. E. WOOLF.

In 1927, the man sustained a fracture of the base of the right superior maxilla and of the right mandible. When seen, he had bilateral Argyll-Robertson pupil. This persisted for a number of weeks, after which the right eye recovered and reacted directly and consensually, although the left eye failed to do so. The Wassermann reaction was negative. There was slight atrophy of the right disk.

AN ATTEMPT TO CLASSIFY (PATHOLOGICALLY) THE VARIOUS FUNDUS PICTURES IN DISEASES OF THE CHOROID. MR. MALCOLM L. HEPBURN.

Mr. Hepburn first referred to his paper on this subject read five years before. He was now approaching it from a different angle. Before the days of ophthalmic pathology, all diseases of the fundus were described in terms of the picture presented by ophthalmoscopic examination; hence, there were an infinite variety of names given by those who claimed to have discovered a new clinical entity, merely because similar pathologic conditions had produced some variation in the picture, due largely to the degree of severity and extent of the pathologic processes. In the various textbooks on ophthalmology, therefore, there were many different classifications. The terms "retinitis" and "choroiditis" had been exchanged, or combined indiscriminately, with but little consideration where the pathologic processes first started. Mr. Hepburn's object in this paper was to indicate a direction in which methods of description might be revised. Pathologic investigations of the last thirty years had now reached a point when it was justifiable to build on them a sound classification of diseases of the fundus.

In order to focus attention on the choroid, he indicated the chief differences between retinal and choroidal pictures. The chief difference was that in choroidal diseases there was always some proliferation or migration of pigment at the final stage of the pathologic reaction, while in retinal conditions, development of pigment at any time was rare. The amount of pigment visible in the picture depended on the patency of the various channels through which the pigment could pass. If the normal structures were but little interfered with, as in primary pigmentary degeneration of the retina, the passage of the pigment was not restricted as to its choice of channels; it was therefore widely distributed in the affected area. When a large development of cicatricial tissues occurred, many of the ordinary channels were crushed out of existence; in consequence the pigment was hindered in its progress and appeared only at the margins of the scar or in irregular patches in the neighboring boring area.

Among diseases of the choroid, the first mentioned by Mr. Hepburn were those of the inflammatory type. In this group, a sudden failure of sight occurred, though not a complete loss; examination disclosed vitreous opacities, keratitis punctata, and in the fundus a yellowish-white, slightly raised edematous patch, round or oval, with an ill-defined edge. It was the number of metastatic deposits, their position, size and depth in the choroidal stroma, or degree of severity, which made the differences in the picture. Only in this class should the term "choroiditis" be used, that is, an inflammation of the choroid.

The second group, including cases due to disease or obstruction of the choroidal blood vessels, was called the vascular type. The signs and symptoms might occur suddenly, or slowly and gradually. The ophthalmic appearances and clinical history were similar to those in the inflammatory group, but with differences according to the size of the vessel or vessels involved. There was usually little vitreous opacity and no keratitis punctata. There was some outlying exudate, to which the name retinitis circinata had been applied. The condition given this name had often been described as a separate disease, but unjustifiably.

There was one disease, occurring at the macula, which it could be claimed was a special entity, namely, the Tay-Sachs disease (or amaurotic family idiocy); except for the fact, however, that it was peculiar to a special type of person it was locally a purely retinal disease, the degeneration beginning in the ganglion cell layer.

The only way to prove the existence of retinal degeneration secondary to any disease of the choroid was by noting the effect on the central vision, or by looking for scotomas in the various parts of the visual field corresponding to the areas involved, as it was not possible to ascertain ophthalmoscopically the condition of the neuro-epithelial and other layers of the retina.

Another variety of disease in the vascular group was secondary pigmentary degeneration of the retina due to interference with the blood supply through the medium-sized vessels. In these cases the pigment was deposited on a grayish fundus, owing to the development of fibrous tissue in the stroma of the choroid. These cases should not be described as retinitis pigmentosa, this term being applicable to the primary condition alone.

The greatest amount of confusion, however, surrounded the interpretation of pictures of scars, the results of acute conditions which had passed the initial stages without having attracted the patient's particular attention; or of slowly progressive defects which had advanced to a stage when they demanded attention. Some were revealed in a routine examination of the eye.

There were many borderline types of pictures which might be interpreted as either an inflammatory or a vascular condition, but an attempt should be made to arrive at a definite conclusion. Those which presented difficulty in diagnosis were those most likely to be associated with failure of development or due to intrauterine inflammation.

The clinical significance of this contribution in the treatment of patients was successful in that it showed the importance of determining whether an acute inflammatory condition was being dealt with, or one which consisted primarily of a defect in the vascular system.

The next group of diseases were hyaline, calcareous and other degenerations. Hyaline degenerations of the membrane of Bruch were generally seen as small round yellowish patches bordered by narrow margins of pigment. They might occur in any part of the fundus, were often widespread, and often of irregular shape. The commonest situation, however, was around the disk and the macula. These patches were frequently seen in quite young people. Visual acuity was seldom affected in the regions where they occurred.

The next group were the congenital conditions, of which a number of pictures were shown on the epidiascope. In addition, the group comprised the colobomasta, to which Mr. Hepburn referred in detail in a paper five years ago.

The fifth group, that of new growths, as obviously a special pathologic entity.

Still another group included conditions resulting from concussion and ruptures of the choroid. Mr. Hepburn was prepared to accept these also as a separate entity.

Mr. Hepburn said he felt that some effort should be made, by a special committee, if need be, to standardize the description of pictures of the fundus, especially in relation to diseases of the choroid.

The paper was illustrated with many drawings shown on the screen.

There was no discussion, but the president of the society expressed the hope that some of the points made by Mr. Hepburn would find their way into textbooks on the subject.

JUVENILE GLAUCOMA. MR. M. S. MAYOU.

The term juvenile glaucoma, was applied to glaucoma occurring between the ages of 15 and 40 years. Mr. A. Hugh Thompson, one of the first observers of it in England, published the report of five cases in the *Ophthalmic Review* in 1909, pointing out that it was a chronic form of glaucoma with exacerbations, the latter not being congestive. Most of the patients presented themselves when one eye had become blind, or nearly so. In nearly all the recorded cases the anterior chamber was deeper than normal, and in some of the cases, congenital remains were present in the other eye.

There was much difference of opinion as to whether these cases belonged to the congenital group or were early manifestations of the senile form of glaucoma. As the anterior chamber was deep and these patients had other congenital manifestations, the condition seemed to be congenital in origin. The field of vision was not recorded in the published cases, but this was most important, from the standpoint not only of etiology but also of treatment. In two cases the fields were contracted; there were scotomas in them, apart from the enlargement of the blind spot. In both those cases, also, there were scotomas close to the fixation point accounting for loss of central vision in one eye of each patient, while the central vision of the other eye was seriously impaired. Mr. Mayou gave particulars of the cases.

Two patients with buphthalmos, operated on in childhood, now had good vision, without scotomas. Similarly in the senile form of this disease, apart from the scotomas associated with the blind spot, isolated scotomas were rarely found elsewhere in the fields of vision. Possibly these scotomas might be due to pressure on the nerve fibers passing over the edge of the disk by some anatomic distribution of the retinal vessels. The great importance of this type of scotoma clinically was that, as a rule, patients presented themselves when the sight of one eye was lost and the second eye was beginning to show signs of the scotoma in the macular region before the peripheral field or the blind spot became affected, should the condition not be recognized.

Operations for the relief of tension seemed to be universally successful.

Book Reviews

EDITED BY DR. FRANCIS HEED ADLER

THE EYE. By C. W. RUTHERFORD, M.D., F.A.C.S., Indianapolis, Ind., Associate in Ophthalmology, School of Medicine, University of Indiana. Price, $7.50. Pp. 404, with 305 black and white figures and 120 original colored plates. New York: D. Appleton & Company, 1928.

The author states that the needs of the general practitioner and student of medicine have had first consideration in the preparation of the text. The teacher's point of view as to these needs will differ. To the reviewer this work covers the subject of ophthalmology too comprehensively and too briefly to meet the needs ideally. Less than ten pages are given to the anatomy, anomalies and diseases of the choroid. A disproportionate space is given to surgical conditions of the lids; there are at least forty illustrations of various operations. There are but eight colored plates illustrating several fundus conditions; these do not include such important conditions for the general practitioner and student as papilledema, nephritic retinitis, glaucomatous cupping, etc.

The commoner diseases of each structure have been described, while those of less frequent occurrence have been discussed as an aid to differential diagnosis. Under differential diagnosis of exudative choroiditis it is stated that "Choroiditis juxtapapillaris or Jansen's (sic) disease is found next to or in the vicinity of the disk. The pigment is not sharply heaped up nor so black. It has been observed in cases having a remote focus of low grade infection. Corresponding scotomata appear in the visual fields." Such a description will scarcely aid in a recognition of this condition. It is stated that "Instead of incorporating prisms, lenses may be decentered to obtain a prism effect. The optician will attend to this." This could not be considered a commendable suggestion from a teacher.

The author's style is concise and clear and well adapted for teaching. The black and white illustrations of operations are on the whole excellent. There is a comprehensive table of contents and index.

W. Z.

AN INTRODUCTORY COURSE IN OPHTHALMIC OPTICS. By ALFRED COWAN, M.D. Price, $3.50. Pp. 262, with 121 illustrations. Philadelphia: F. A. Davis Company, 1928.

This book is the outgrowth of the author's lectures and experiments in his course on physiologic optics in the Graduate School of Medicine of the University of Pennsylvania. Its purpose, as modestly stated in the preface, is to convey a working knowledge of ophthalmic optics to students and practitioners who possess only an elementary knowledge of mathematics. In this Dr. Cowan has most assuredly succeeded, for his clear diction in explaining his many experiments and diagrams makes his book most readable and understandable.

The volume is comprised of thirteen chapters and an index. The laws of reflection and of refraction are fully explained in the first five chapters, while the sixth is devoted to "lenses." Here the author gives

a clear description of the optical properties of all types of lenses. After having thus familiarized his reader with optics, he describes the dioptric system of the eye. This is followed by an explanation of the optic defects found in all forms of ametropia and by a clear presentation of the principles involved in retinoscopy and ophthalmoscopy.

The numerous diagrams used in this book make it appear at first glance dry and too mathematical, but further study of it will show the wisdom of the author's scheme of having each law followed by an experiment or diagram proving it.

This well printed and excellently arranged book is a clear and concise presentation of a difficult subject. It is to be recommended to all who are interested in ophthalmic optics.

JOHN H. DUNNINGTON.

CILIARY MOVEMENT. By J. GRAY, Fellow of King's College and Lecturer in Experimental Zoology in the University of Cambridge. Price, $4.25. Pp. 170. New York: The Macmillan Company, 1928.

This little book has nothing to do with the movement of the ocular cilia but is an interesting compendium of the existing knowledge regarding cilia in the animal and plant kingdom. The movements of cilia are adequately discussed according to the hypotheses of Schäffer, Heidenhain and others.

The force exerted and the work done by cilia is treated in another chapter, and the relation of ciliary movements to changes in the ionic concentration of the surrounding fluid is ably handled, the author having done considerable original work in this particular field.

The functions of cilia throughout the animal kingdom is the subject of the last chapter, but being a biologist the author gives little room for a discussion of ciliary movement in the mammalian body.

The book is well illustrated and surprisingly nontechnical for a subject which is usually treated by the abstruse sign language of biometrics. It makes enjoyable reading for anyone whose interests wander to biologic fields.

FRANCIS HEED ADLER.

INTERNATIONAL CLINICS. Edited by H. W. CATTELL, M.D., Philadelphia, with numerous collaborators. Thirty-Ninth Series. Pp. 303. Philadelphia: J. B. Lippincott Company, 1929.

This volume contains a report of three clinics held by Prof. L. F. Barker, an article on bacteriophagy by d'Harcelle and articles on a number of subjects under the heads of Diagnosis and Treatment, Surgery, Obstetrics, and Progress of Medicine in 1928. An article which is of special interest to ophthalmologists is that entitled, "Biomicroscopy (Slit Lamp), a Clinical Aid to Diagnosis in Ocular Diseases," by Harvey E. Thorpe, M.D., of Pittsburgh, Pa. This gives in thirty pages an illustrated introduction to this new and important method of examination. The matter is based on that found in the recognized textbooks. The instrument is first described; then follows the technic of its use and its clinical application as an aid in diagnosis.

A. K.

Directory of Ophthalmologic and Otolaryngologic Societies *

FOREIGN

OXFORD OPHTHALMOLOGICAL CONGRESS

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford, England. Time: July 4-5, 1929.

INTERNATIONAL

INTERNATIONAL CONGRESS OF OPHTHALMOLOGY

President: Dr. E. Treacher Collins, 17 Queen Anne St., London, England.
Secretary: Dr. E. Mark, Academisch Zickenhuis, Leyden, The Netherlands.
Place: Amsterdam, The Netherlands. Time: Sept. 5-13, 1929.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.
Place: Portland, Ore. Time: July 10-12, 1929.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Harris P. Mosher, 828 Beacon St., Boston.
President-Elect: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Atlantic City, N. J. Time: Oct. 21-25, 1929.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. Walter R. Parker, David Whitney Bldg., Detroit.
Secretary: Dr. Emory Hill, 501 E. Franklin St., Richmond, Va.
Place: Hot Springs, Va. Time: June 10-12, 1929.

LOCAL

LOS ANGELES COUNTY MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Harold S. Muckleston, 6422 Hollywood Blvd., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 1208 Roosevelt Bldg., Los Angeles.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Dr. Walter A. Wells, 1606 20th St. N. W., Washington.
Secretary: Dr. J. N. Greear, Jr., 1740 M St. N. W., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

ATLANTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. F. McDuffie, 45 Edgewood Ave., Atlanta, Ga.
Secretary: Dr. Leon E. Brawner, 157 Forrest Ave. N. E., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Lafayette Page, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. M. Earle Brown, Maison Blanche, New Orleans.
Secretary-Treasurer: Dr. W. A. Wagner, Pere Marquette Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital, New Orleans. Time: 8 p. m., third Thursday of each month from September to June.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Leon J. Goldbach, 1012 N. Charles St., Baltimore.
Secretary: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St., Baltimore. Time: 8:30 p. m., fourth Thursday of each month from October to May.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. W. Holbrook Lowell, 82 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Eye Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

ST. LOUIS OPHTHALMIC SOCIETY

President: Dr. William H. Luedde, Metropolitan Bldg., St. Louis.
Secretary: Dr. Leo L. Mayer, Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. Charles M. Swab, Acquila Court Bldg., Omaha.
Secretary: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Arts Tea Room. Time: 5:15 and 7:00 p. m. Third Wednesday of each month from October to May.

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Lee W. Hughes, 1019 Broad St., Newark.
Secretary: Dr. Earle LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. Robert M. Rogers, 680 St. John's Pl., Brooklyn.
Secretary: Dr. William F. C. Steinbugler, 515 Ocean Ave., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave., Brooklyn. Time: Third Thursday of February, April, May, October and December.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. M. S. Lord, 148 Barrett St., Schenectady.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.

BUFFALO OPHTHALMOLOGIC CLUB

President: Dr. E. E. Blaauw, 190 Ashland Ave., Buffalo.
Secretary-Treasurer: Dr. A. F. Luhr, Medical Arts Bldg., Buffalo.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. B. Samuels, 57 W. 57th St., New York.
Secretary: Dr. T. B. Johnson, 30 W. 59th St., New York.
Time: 8:30 p. m., third Monday of every month.

ROCHESTER EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Frank Barber, 75 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Cecil B. Hert, 29 N. Goodman St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

CLEVELAND ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Myron Metzenbaum, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Joseph L. McCool, 909 Stevens Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

THE PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg., Pittsburgh. Time: Fourth Monday of each month, except June, July, August and September.

THE PITTSBURGH SLIT-LAMP SOCIETY

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl., Pittsburgh. Time: Second Monday evening of each month, except June, July, August and September.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. Robert R. Hampton, Boston Bldg., Salt Lake City.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.
Place: Salt Lake City. Time: July 1-3, 1929.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. C. E. G. Shannon, 17th and Walnut Sts., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. William Thornwall Davis, 927 Farragut Sq., Washington, D. C.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.

THE MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. John G. McLaurin, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. M. Sellers, Medical Arts Bldg., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. C. P. Schenck, Medical Arts Bldg., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

HOUSTON ACADEMY OF MEDICINE, EYE EAR, NOSE AND THROAT SECTION

President: Dr. John H. Foster, 1300 Walker Ave., Houston, Texas.
Secretary: Dr. Edward W. Griffey, Houston Clinic, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

THE SAN ANTONIO OPHTHALMOLO-OTO-LARYNGOLOGICAL SOCIETY

President: Dr. F. H. Roseborough, 302 Moore Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library, San Antonio, Texas. Time: 8 p. m., first Tuesday of each month from October to May.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Will Otto Bell, Medical-Dental Bldg., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Herschel Ezell, Doctor's Bldg., Nashville, Tenn.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. H. B. Stone, Roanoke, Va.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University, Va.

SPOKANE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

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Secretary: Dr. C. A. Veasey, Jr., Spokane, Wash.

THE MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. L. P. Allen, 145½ Main St., Oshkosh, Wis.
Secretary-Treasurer: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

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